Calf management

DAIRY

Contents

This guide was produced in association with the University of London Royal Veterinary College as part of the AHDB Dairy Animal Health, Welfare and Nutrition Research Partnership.

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Introduction

After feed, raising heifer calves is the second largest annual expense for dairy businesses, accounting for approximately 20% of production costs. Heifers produce no income until they reach first lactation and no profit until the second lactation. Heifers are the future of the dairy herd and deserve to have the best management, incorporating the latest research and management advice. In return, they will repay the investment through higher milk production and a longer productive life.

Every day, dairy farmers make decisions that can affect the health and welfare of their calves. Research at the Royal Veterinary College has shown that, on GB farms, mortality rates of liveborn dairy heifers in their first month of life ranged between 0% and 12%. The fact that farms achieving low mortality rates exist indicates that losses can be avoided when good management practices are in place.

AHDB Dairy has produced this guide and associated short films to provide information on how to optimise calf performance. To rear healthy calves and keep mortality to a minimum, the following must be considered:

- Making the most of colostrum
  - The three Qs of colostrum management (Quality, Quantity and Quickly)
  - Colostrum hygiene
  - Testing colostrum using a Brix refractometer and colostrometer
  - Tube-feeding colostrum
- Ensuring thermal comfort and sufficient feed intakes
- Monitoring growth rates (weight and height)

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Key messages

- Newborn calves must receive at least 3 litres of high quality colostrum within the first 2 hours of birth, followed by a further 3 litres within 12 hours of birth
- Test colostrum quality using a Brix refractometer or colostrometer. Feed colostrum with at least 50 g/L of antibody (IgG)
- Teat-feeding with a bottle is best
- Use a feeding tube if a calf is unable to suck a bottle or is too weak to consume the full amount of colostrum
- Ensure colostrum hygiene. Test colostrum for bacterial counts to identify if improvements are needed during collection and storage
- Blood-test calves to check that the antibody (IgG) in the colostrum has been successfully transferred to the calf
- Regularly monitor growth rate. Weigh or measure height at birth and then 1 week post-weaning, at 6 months of age and at breeding

The three Qs of feeding colostrum: Quickly, Quantity and Quality

Colostrum is vital to the newborn calf because it contains antibodies (also known as immunoglobulins, or IgG), which provide immunity. It is also rich in energy and nutrients that are essential for growth.

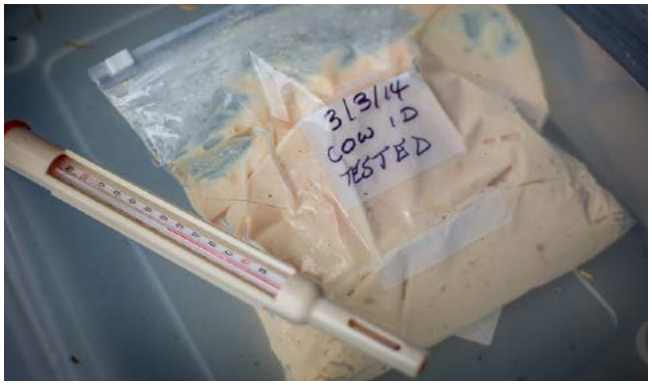


Figure 1. Colostrum should always be tested, bagged and labelled if stored

Quality

Action: Feed high quality colostrum that has been measured using a Brix refractometer or colostrometer.

- Good quality colostrum contains at least 50 g/L of IgG. Any colostrum containing <20 g/L of IgG should not be used
- Colostrum quality declines the longer it is held in the udder
- It is not possible to determine the quality of colostrum by looking at it: it must be tested
- Test colostrum from all cows. Ensure cows are milked as soon as possible after calving so that the best possible colostrum is collected and fed to newborn calves
- Quality will decline if the colostrum becomes contaminated with bacteria, so collect and store it hygienically

Figure 2. Colostrum quality declines after 6 hours

Quantity and Quickly

The recommendation is to give a first feed of 3 litres within the first 2 hours. This can be split into two feeds if necessary, particularly for smaller breeds, and should be followed up by another similarly sized feed within 12 hours of birth.

The colostrum should be fed at body temperature of 38°C.

To optimise immunity, it is very important that calves receive their first colostrum feed as soon as possible after birth, ideally within 2 hours.

Calves lose their ability to absorb antibodies in the first few hours of life. By 20 hours after birth, this ability is nearly gone.

Ensure you have a supply of good quality frozen colostrum from cows of known health status, which can be used if a dam's own colostrum is of insufficient quality.

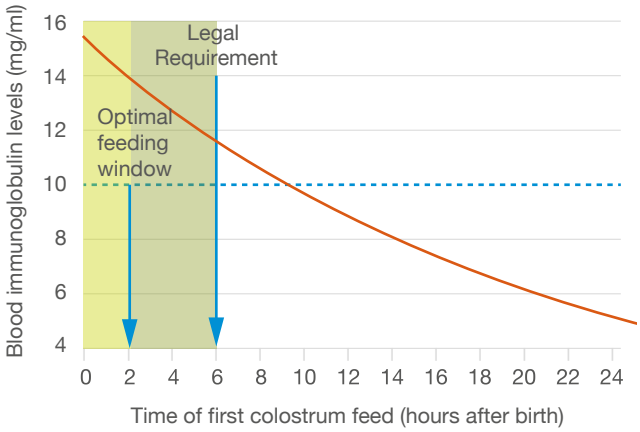


Figure 3. Effect of time of first colostrum feed on antibody absorption. After 10 hours, the calf's ability to absorb enough IgG is dramatically reduced

- Optimal feeding time for colostrum is within the first 2 hours of birth, but the legal requirement is within the first 6 hours of birth
- Feeding colostrum to calves over several days is beneficial for building immunity and fighting infections

Method of feeding

Calves left to suck their dam are 2.4 times more likely to receive insufficient antibodies. You should, therefore, feed the calf by either:

- **Bottle** – promotes transit of the colostrum to the true stomach
- **Tube feeding** – ensures that the full volume of colostrum is received by the calf – however, this is a skilled technique that can only be undertaken safely by trained staff

If you start using a bottle and the calf does not drink it all, the remainder should then be given by tube to make sure the calf receives the full 3 litres.

Figure 4. Maintain high standards of cleanliness in both feed preparation and housing

Monitoring

Providing sufficient, good quality colostrum within 6 hours of birth will reduce calf mortality and disease.

Blood testing

Blood testing your calves can tell you about the effectiveness of your colostrum management. Ask your vet to take samples from at least 12 calves within 1 week of their birth. Samples can be tested for either the antibody (IgG) level or the total protein (TP) in the blood. If less than 80% of the group are categorised as 'good', the potential causes of this should be examined.

Table 1. Antibody (IgG) and total protein (TP) blood test recommendations

Quality	IgG g/L	TP g/L
Good	>12	>55
Marginal	10–12	50–55
Poor	<10	<50

Future care

Even good quality colostrum that is fed on time contains limited antibodies. The newborn calf does not yet make more of its own antibodies. Therefore, it is vital to continue giving good quality colostrum by:

- Keeping the calf in a suitable environment
- Providing sufficient feed
- Maintaining high standards of cleanliness in both feed preparation and housing

Summary of recommendations

Feed the right quantity of good quality colostrum to all calves as soon as possible after birth.

Remember the three Qs:

- **Quantity – 3 litres**
- **Quality – contains at least 50 g/L of IgG**
- **Quickly – within 2 hours of birth**

Colostrum hygiene

Contamination during collection, transfer or feeding puts the calf at risk by introducing harmful bacteria.

Quality

Collect colostrum as soon as possible after the cow has calved. Remember to test all colostrum to determine the level of antibody present.

Collect colostrum hygienically

Attention to hygiene is vital.

Know the disease status of your cows. Do not collect colostrum from cows that are positive for Johne's disease or suffering from postcalving conditions.

Ensure udder cleanliness. An effective teat disinfection routine will remove bacteria. Teat preparation should be carried out to remove any teat sealant.

Avoid contaminating the colostrum yourself. Make sure your hands are clean: ideally, wear gloves.

After every use, sanitise the cluster and pipework inside and out.

Use a clean dump bucket (as pictured below) and transfer the colostrum to a clean bucket with a lid.

Storing colostrum

In warm colostrum, bacterial numbers can double every 20 minutes.

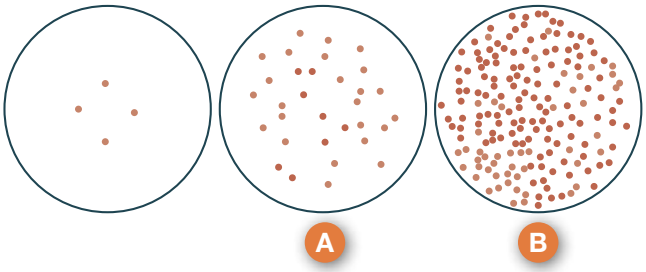


Figure 6. A) Bacteria after 1 hour. B) Bacteria after 2 hours

Fresh colostrum should be fed to calves within 1 hour of collection, or pasteurised and stored appropriately.

There are three ways to help reduce the rate of microbe multiplication: refrigeration, freezing and pasteurisation.

Table 2. Colostrum storage methods

	Refrigeration	Freezing
Length of storage	24 hours	Up to 1 year
Storage method	1–2 litre containers	1–2 litre zip bags/purpose made flat
Storage Temperature	4°C	-18 to 20°C

Ensure all stored colostrum is labelled with the collection date and cow identity. This is particularly important if the cow later tests positive for Johne's disease.

Remember to use a thermometer to regularly check the temperature of fridges and freezers.

Figure 5. Dump bucket

Pasteurising colostrum

Pasteurisation is not a storage method but a way to reduce the number of bacteria present. Therefore, pasteurised colostrum must still be chilled or frozen.

If using a pasteuriser, refer to the manufacturer's instructions with regards to batch quantities.

Pasteurisation does not make low quality or highly contaminated colostrum fit to feed.

Preparation

Colostrum should be fed at body temperature of 38°C.

Frozen colostrum can be thawed in the refrigerator overnight.

Colostrum should be warmed in a water bath at a maximum temperature of 50°C so that the colostrum itself reaches 40–42°C. This allows the colostrum to cool slightly before it reaches the calf.

Once warmed, use within 30 minutes.

Check the temperature using a thermometer.

Hygiene testing

If you are concerned about the risk of feeding contaminated colostrum to your calves, you can have the colostrum tested.

Testing colostrum for bacterial counts can help identify whether changes are needed to the ways in which colostrum is collected and stored.

The sample should be taken just before it is fed to the calf.

Ask your vet for more details.

Important

Do not overheat or use a microwave to reheat or thaw the colostrum because this will destroy the antibodies.

1 Store colostrum carefully to maintain its quality and ensure it is readily available so that it can be fed quickly

2 Using a water bath with a thermometer, as pictured below, is a good way to thaw colostrum

3 Warmed colostrum must be fed to calf at 38°C within 30 minutes

Using a Brix refractometer

It is important to test colostrum at every collection. The test results help you to make an informed decision as to whether the colostrum is good enough to be fed or stored, or needs to be discarded.

Equipment

Refractometers should be calibrated before each use and be free from any visual dirt and contaminants such as manure. You should also check for any cracks or breaks in the glass.

You will need:

- Clean refractometer 0–32% scale
- Distilled water
- Clean cloth
- Sterilised jug
- Colostrum at room temperature

Procedure

1. The refractometer should be calibrated before every use. Put 2–3 drops of distilled water on the glass surface.
2. Lower the cover over the sample so the water spreads across the entire surface without any air bubbles or dry spots.
3. Allow 15 seconds before taking a calibration reading – this allows the sample to adjust to room temperature.
4. Hold the refractometer up to natural light while looking down the eyepiece. Avoid fluorescent light sources.
5. As you look down the eyepiece, you will see a circular field with graduations down the centre. The scale should read zero where the light and dark areas meet. If not, adjust using the calibration screw.
6. Wipe the surface clean with a clean soft cloth.
7. Once dry, place a couple of drops of colostrum onto the glass surface and repeat the process.
8. Take a quality reading for the colostrum.
9. When you are happy with the reading, ensure you clean the slide and glass ready for next time.

Figure 7. Once the equipment has been calibrated with water, a droplet of colostrum is placed on the Brix refractometer

Figure 8. Look through the equipment to read the result

Taking a reading

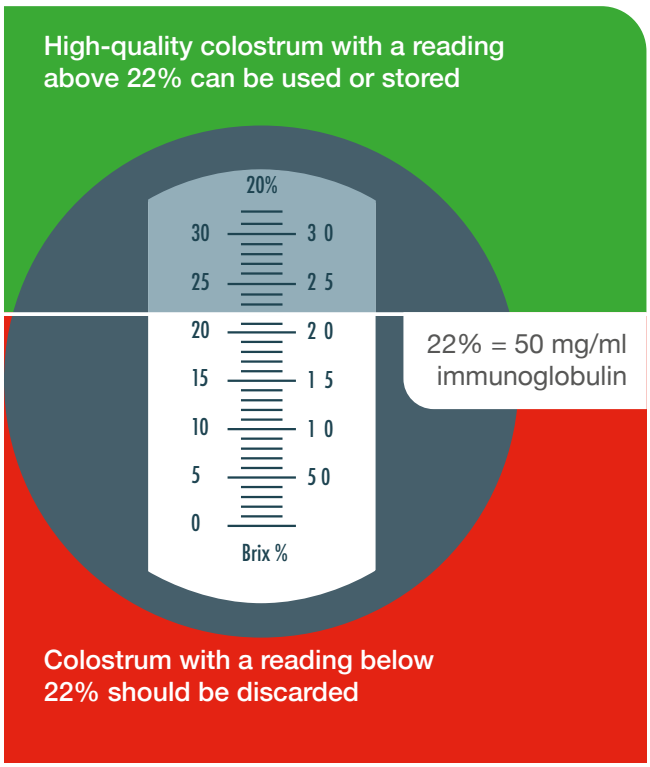


Figure 9. Brix refractometer–0-32% scale

Using a colostrometer

It is important to test colostrum at every collection. The test results help you to make an informed decision as to whether the colostrum is good enough to be fed or stored, or needs to be discarded.

Equipment

Check the colostrometer is free from any visual dirt and contaminants such as manure. You should also check for any cracks or breaks in the glass.

You will need:

- Clean colostrometer
- Sterilised jug
- Colostrum at room temperature
- Measuring cylinder tall enough to allow the colostrometer to float

Procedure

1. Use a clean dump bucket and transfer the colostrum to a clean bucket with a lid.
2. Take a sample of the colostrum, using a sterilised jug.
3. Pour the colostrum into the measuring cylinder.
4. The colostrum should be tested at a fixed temperature. This is ideally at a room temperature of 22°C – not body temperature or straight from the refrigerator.
5. There should be no froth on the colostrum.
6. The colostrometer should be floated in the colostrum. Leave for 1 minute before taking a reading.

Figure 10. There is no way of assessing colostrum quality by eye – density and colour are not accurate indications

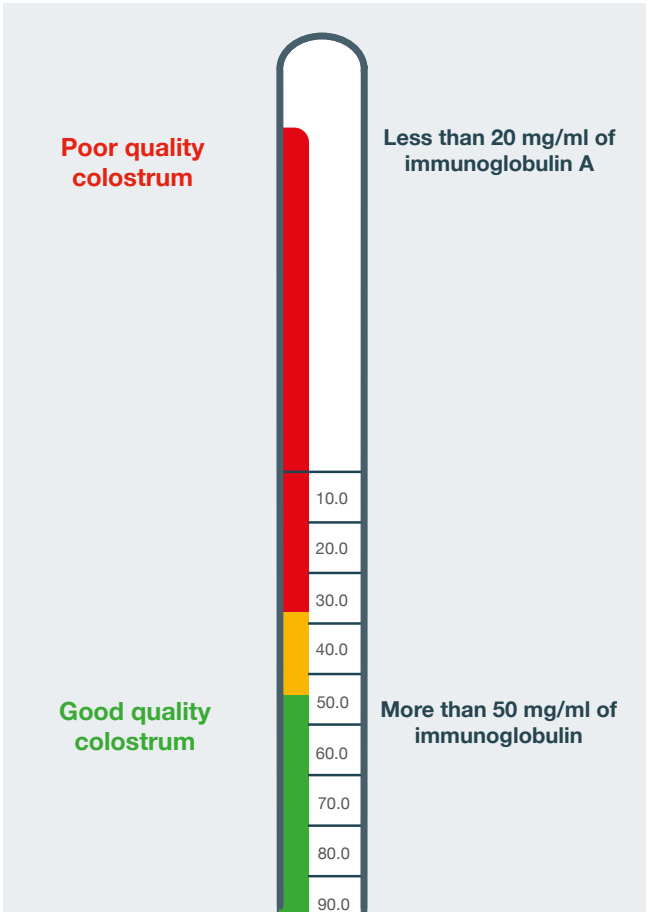
Taking a reading

Read the value at the level at which the colostrometer is floating at the surface of the colostrum.

Readings in the green zone indicate good quality (more than 50 mg/ml of immunoglobulin) – this colostrum can be used or stored.

Readings in the red zone indicate poor quality (less than 20 mg/ml of immunoglobulin) – this colostrum should be discarded.

Readings in the amber zone indicate marginal quality.



Tube feeding colostrum to calves

Proper care of newborn calves is critical for their long-term health and survival. If a calf is unable to suck a bottle or consume the full amount of colostrum, then a stomach tube should be used. This is a skilled technique that requires training to ensure correct placement of the tube.

See how to tube-feed a calf using our Colostrum Feeding video on the AHDB Dairy YouTube channel, **youtube.com/AHDBDairy**

Method of feeding

You will need:

- Feeding tube (plus a spare)
- At least 3 litres of colostrum warmed to 38°C

Before feeding any colostrum to the calf, make sure all equipment has been thoroughly cleaned and is in good working order.

Sharp edges or disintegrating rubber can harbour bacteria and may damage the calf's mouth.

Inserting the tube

- Before inserting the tube into the calf's mouth, moisten the tube with warm water or colostrum
- Holding the calf's head in a natural position, slowly pass the tube over the tongue to the back of the mouth
- The tube should enter the oesophagus, which is directly above the windpipe
- Extreme care is needed to ensure the tube enters the oesophagus and not the windpipe
- Stop immediately if you feel any resistance – pull the tube out slightly and redirect. The tube should never be forced
- When the tube is in the correct position, the calf should be comfortable and swallowing

Handling the calf

- An easy way to handle the standing calf is to back the calf into a corner with one hand under its muzzle to keep its head and neck in a natural position
- Work quietly and calmly to minimise stress to other animals in the pen
- If carrying out this task within the calving pen, be aware of the cow's maternal instinct to protect her calf
- Before inserting the tube, ensure it is the right length for that particular calf. The tube should be measured from the tip of the calf's nose to the point of the elbow behind the front leg and this point marked

Figure 11. Measuring tube length for calf

Important

Avoid tubing calves that are lying down: milk can enter the lungs, which can cause death.

Checking placement

- The windpipe is a harder structure with rings obvious to the touch, while the oesophagus is a softer, collapsible structure
- When the tube is in the correct position, it will inflate the oesophagus, meaning that both structures can be felt

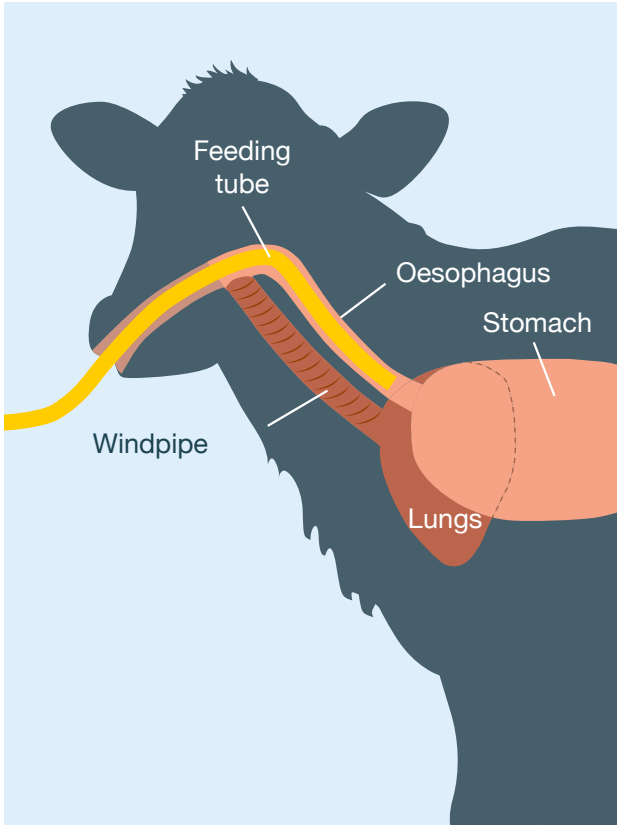


Figure 12. Diagram of correct placement

Administer colostrum

- When the calf is comfortable and you are happy with the position of the tube, the colostrum can be introduced
- The liquid should be fed at body temperature of 38°C
- Control the flow rate of the colostrum by raising and lowering the bag
- Keeping the bag low will be more comfortable for the calf

Figure 13. A tube fed calf

Top tips

Feed the colostrum at a slow rate to minimise regurgitation.

Removal of the tube

- When the calf has finished the colostrum, kink the tube and withdraw it in one swift movement
- The calf's head should be tilted down so that any milk coming forward does not go into the lungs

Important

Removing the tube prematurely, while there is still liquid in the bag/tube, may cause colostrum to enter the lungs.

Cleaning the equipment

- Immediately after use, the feeding tube should be rinsed, then thoroughly cleaned and disinfected
- Hang the tube in a clean, dry environment so it can drain and dry

Dehydrated calves

Once this technique is mastered, it can also be used to give electrolyte fluid to dehydrated calves and older animals.

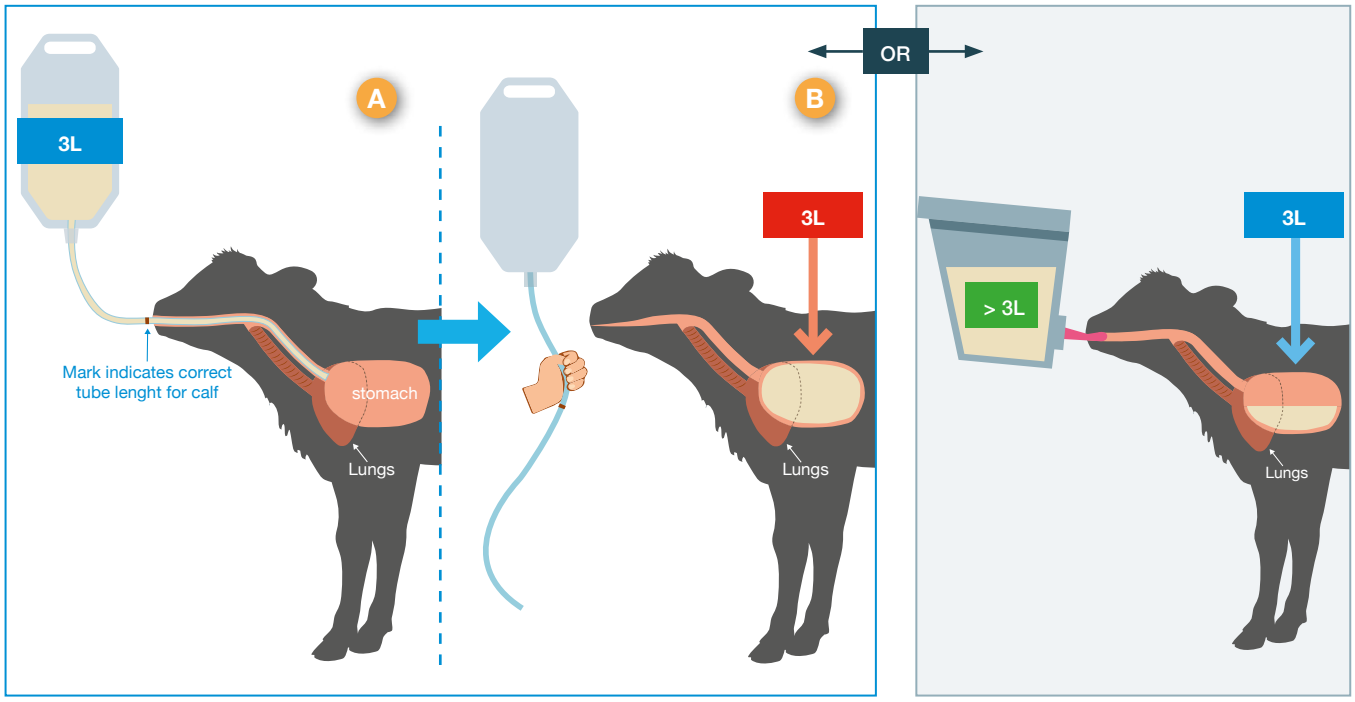


Figure 14. Feeding 3 litres of good quality colostrum in the first 2 hours, followed by 3 litres in the next 6–12 hours, should overcome problems with low quality colostrum. If fed by a bucket more can be fed, but caution is advised with tubing more than 4 litres

Ways of feeding milk

The best measure of a successful calf rearing system is production of a healthy calf that has reached its targeted weaning weight.

How much milk to feed

Traditionally, the recommendation to feed calves at 10% of body weight was translated into feeding 2 litres of milk twice daily. This does not provide growing calves with sufficient energy.

Feed 15–20% of calf body weight in whole milk or suitable milk replacer.

Remember: as calves grow in size, they will require more energy, so volume and energy must be increased. Benefits from feeding the correct energy and volumes of milk include improved health, growth rates, feed efficiency and lifetime milk performance.

It is a legal requirement that calves less than 28 days old must be fed with at least two liquid milk feeds per day.

Using milk produced on farm

Provide whole milk from cows that are healthy and disease-free.

Know the disease status of your cows. Do not feed milk from Johne's positive cows.

Do not feed waste milk (antibiotic-treated, mastitic or high cell count) to calves. Feeding this type of milk can increase the risk of disease transmission and antibiotic resistance in the calf.

Best method – teat or bucket?

Teat feeding is more natural. Drinking from a teat helps the calf satisfy their urge to suckle.

Figure 16. A single-teat calf feeder

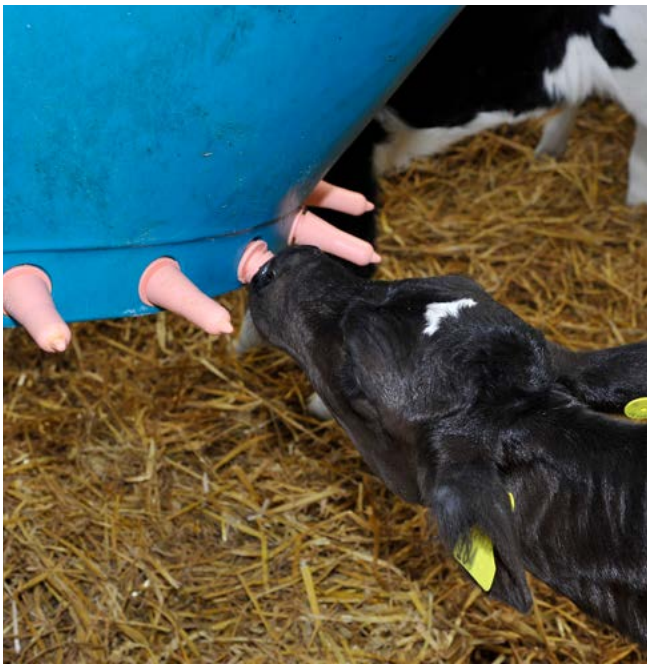


Figure 17. A multi-teat calf feeder, suitable for feeding group housed calves

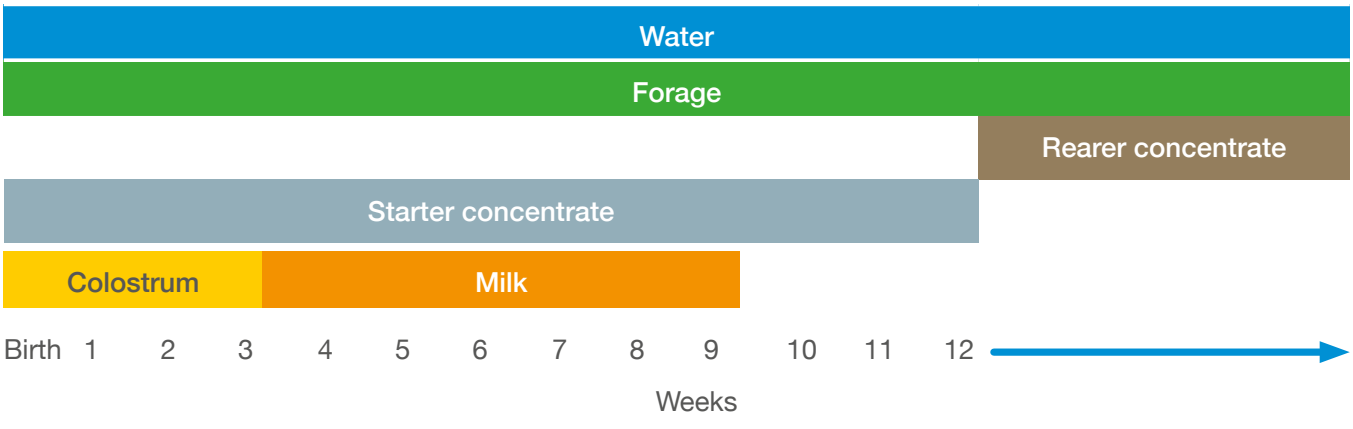


Figure 15. Example rearing/feeding timeline. Note, milk fed will increase with age as energy requirements increase (Table 3)

Milk feeding hygiene

It is necessary to maintain high standards of hygiene to prevent the development of biofilms on all items of milk-feeding equipment.

Once biofilms have formed, further milk residues will stick to the biofilms and create an environment in which bacteria will thrive. It is then very difficult to reduce these bacterial populations.

Biofilms release bacteria and will contaminate milk every time equipment is used.

To reduce biofilm formation, follow the six-step milk-feeding equipment washing protocol.

Causes of biofilms

- Initial rinse is too hot
- Inadequate brushing so not all organic material is removed
- Washing water is too cool
- Plastic equipment is damaged, making it easier for bacterial particles to stick to cracks and rough surfaces

Watch online

For more information see the AHDB Colostrum Hygiene film on the AHDB Dairy YouTube channel youtube.com/AHDBDairy

Figure 18. Six-step milk-feeding equipment washing protocol

Figure 19. Cleaning milk equipment

The amount of whole milk or milk replacer to feed will depend on body weight, desired growth rate, environmental temperature and nutritional composition.

Energy requirements

To determine whether a growing calf is receiving enough energy from milk replacer or whole milk to meet its growth rate targets, the calf's energy requirements should be calculated. The energy content of whole milk (3.28% protein and 4% fat) on a dry matter basis is 22.71 MJ/kg. Using the information from the milk replacer label, the energy content provided by milk replacer can be estimated.

- For calves under 3 weeks old, energy requirements should be met through milk feeding
- For calves over 3 weeks old, energy requirements can be met through a combination of milk and concentrate feeding

The calf's total feed requirements depend on its age, target growth rate and environmental conditions.

Calculating the energy content of milk replacer

Daily metabolisable energy (ME) supply can be estimated from the milk replacer. First, however, an estimation of the energy source lactose is needed.

Lactose is not usually a given constituent on the label, but lactose content can be estimated as the amount of dry matter that is not protein, fat or ash.

Ask the manufacturer whether or not protein, fat, fibre and ash are on a dry matter or fresh weight basis.

- If on a fresh weight basis, moisture must also be deducted
- If not stated, assume 5% moisture

The Calf Milk Replacer Energy Calculator allows farmers to work out the energy supplied by the amount of milk replacer fed to the calf. This tool is available to download from the AHDB website.

Calculating the energy requirements for calves fed only milk or milk replacer

The ME requirements of calves that are fed milk or milk replacer at different liveweights with various daily gains is detailed in Table 3. These energy requirements assume that the temperature of the calf's environment is between 15°C and 20°C.

For each 5°C drop below 15°C, feed calves under 3 weeks of age with extra energy by providing an extra 50 g of milk replacer or 0.33 litres of whole milk per day.

The calculations behind the numbers in the table below are:

ME maintenance – the amount of energy a calf needs to maintain current body weight, calculated as: 4.2 x (0.1 x liveweight$^{0.75}$) at 15°C to 20°C

Total ME for maintenance and growth – calculated as (0.1 x liveweight$^{0.75}$ + ((0.84 x liveweight$^{0.355}$) x (daily liveweight gain$^{1.2}$))) x 4.1868 at 15°C to 20°C

Calculating lactose

Fresh weight basis:
Lactose estimation =
100 – moisture%– crude protein% – fat% – ash%

Dry matter basis:
Lactose estimation =
100 – crude protein% – fat% – ash%

Dry matter basis example:
lactose% = 100 – 26 – 16 – 7 = 51

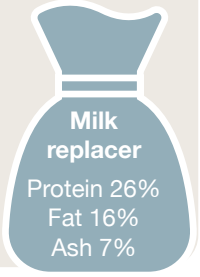


Figure 20. It is important to make sure the calf has sufficient energy to maintain its growth rate

Table 3. Energy requirement (ME) for calves fed milk or milk replacer

Liveweight	Daily liveweight gain (kg/d)	ME maintenance (MJ/d)*	ME growth (MJ/d)*	Total ME (MJ/d)*
35	0.2	6.04	1.81	7.85
35	0.4	6.04	4.15	10.19
40	0.2	6.68	1.89	8.57
40	0.4	6.68	4.35	11.03
40	0.6	6.68	7.08	13.76
45	0.2	7.30	1.98	9.28
45	0.4	7.30	4.54	11.84
45	0.6	7.30	7.38	14.68
50	0.2	7.90	2.05	9.95
50	0.4	7.90	4.71	12.61
50	0.6	7.90	7.66	15.56
55	0.2	8.48	2.12	10/60
55	0.4	8.48	4.87	13.35
55	0.6	8.48	7.93	16.41
60	0.2	9.05	2.19	11.24
60	0/4	9.05	5.03	14.08
60	0.6	9.05	8.18	17.23

The energy requirements reported are from National Research Council, Nutrient requirements of dairy cattle, 7th Edition, 2001.
*These energy requirements are calculated for environmental temperatures between 15°C and 20°C

Figure 21. The most accurate way to weigh calves is to use a set of electronic weigh bars

Calf milk replacers

Milk replacers can be priced differently depending on differences in ingredients, manufacturing technologies and nutritional quality. Producers must understand these differences and make informed decisions.

Advantages and disadvantages of using milk replacer

Advantages

- Reduces risk of disease transfer (e.g. Johne's disease and BVD)
- Consistency of product, when mixed correctly – less risk of digestive upsets and scours

Disadvantages

- Lower energy content than whole milk
- Products with plant-based proteins have lower digestibility in calves under 3 weeks old

Understanding the label

It is difficult to assess milk replacer quality from the label. For labels, the only legal requirement is for ingredients to be listed in descending order of inclusion. Generally, higher quality ingredients are more expensive.

Analysis

The constituents usually listed are crude protein, crude fat, crude fibre, ash and sometimes moisture. Milk replacer should contain 20–26% crude protein and 16–20% fat to achieve optimal growth rates in early life.

Protein

Protein is necessary for tissue growth. Protein sources in milk replacer can be milk-based (e.g. dried skimmed milk, dried whey, delactosed whey, casein), egg based or plant-based (e.g. soya, wheat gluten, pea).

Calves, particularly those under 3 weeks of age, are better able to digest powders with milk-based proteins.

Skim and whey milk proteins

Skimmed milk-based powders are, typically, around 80% casein and 20% whey. The casein forms a clot in the abomasum and is digested like whole milk. It is important to mix to the correct concentrates to allow the clot to form. Whey-based powders are digested in the small intestine and the absence of casein means they do not form a clot in the abomasum.

Traditionally, it was thought that non-clot-forming milk replacers were inferior and responsible for scours in young calves. Recent research does not support this and instead suggests that the poor performance of calves on some milk replacers is more to do with the ingredients and the age of the calf.

Oil and fat

Generally, vegetable fats (palm oil, coconut or soybean) have similar digestibility to milk fat in calves over 3 weeks old.

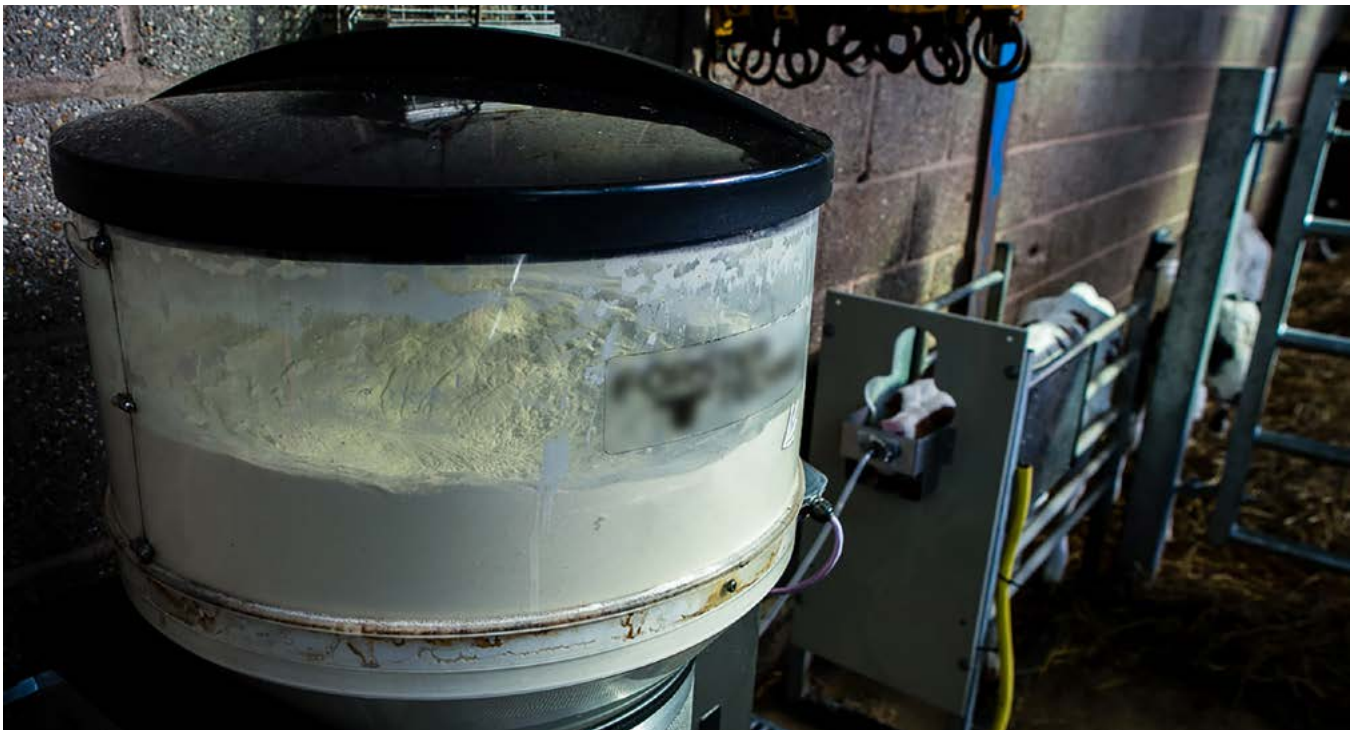


Figure 22. Consistent feeding temperature, total solids and nutrient levels help calves to perform at their best

Important

For calves under 3 weeks of age, vegetable fats may increase the risk of scour.

Fibre

Fibre is an indicator of protein quality. The ingredient list should be viewed to determine the protein sources.

- Products with less than 0.15% fibre contain milk or egg
- Fibre levels over 0.20% indicate the inclusion of plant proteins

Moisture

- It is not always clear if the analysis is on a dry matter or fresh weight basis
- If moisture is reported, the analysis is on a fresh weight basis
- If moisture is not reported, ask the manufacturer whether protein, fat, fibre and ash are analysed on a dry matter or fresh weight basis
- If analysis is on a fresh weight basis and moisture content is not stated, then assume 5% moisture

Ash

Ash indicates the overall level of minerals.

- The ash content should not be higher than 8%

Vitamin and minerals

Declared minerals and vitamins vary little between milk replacers and do not usually warrant routine inspection.

Other considerations

- Reconstitute milk replacer at the concentration required to achieve targeted growth rates and clot formation
- Consistency is the key
- Always read the label and mix to the manufacturer's directions
- It is recommended to feed at least 6 litres per day, up to 150 g/L, during normal environmental conditions
- Use only reputable products, otherwise calves may experience health problems and poor growth rates
- Maintain a high standard of cleanliness throughout the preparation and feeding process
- Ad-lib clean water is essential from birth for good rumen development and feed intake
- Calves have a higher energy requirement in cold environmental temperatures

Watch online

AHDB Dairy has a film on best practice hygiene in the calf shed youtube.com/AHDBDairy

Table 4. Milk replacer labels should show information on both nutritional analysis and additives

Analysis (on dry matter)			
Crude protein	26%	Calcium	0.8%
Crude oils and fats	16%	Sodium	0.5%
Crude fibre	0%	Phosphorous	0.7%
Crude ash	7%		
Ingredients (in descending order of inclusion)			
Fat-filled whey powder, whey powder, whey protein low in sugar, soya protein concentrate, hydrolysed wheat gluten, whey protein concentrate, L-lysine, HCl, trace element/vitamin supplement, citric acid, DL-methionine, emulsifier – lecithin			
Additives per kg			
Vitamins		**Trace elements**	
Vitamin A	25,000 IU	Cobalt	0.2 mg
Vitamin D3	6,000 IU	Copper	10 mg
Vitamin E	250 IU	Iodine	0.25 mg
		Manganese	30 mg
		Selenium	0.3 mg
		Zinc	50 mg

Managing the transition to solid feed

At birth, the rumen is small, undeveloped and does not contribute to digestion. The rumen must develop before it can digest forages. Concentrate and water intake are the most important factors for rumen development.

Rumen development

If stimulated early on, a calf's rumen can start to function from as early as 5 days of age. Most calves are actively ruminating by 28 days of age.

Consumption of concentrates and water provides the rumen microbes with the nutrients they need to grow and multiply.

After 3 weeks of eating starter concentrate, the rumen will have enough microbes to ferment the feed and supply the calf with energy.

Starter concentrate

Calf starter should be offered from Day 1.

- Starter can be provided as a pellet or coarse feed and should be highly palatable to encourage early intake
- Ensure starter has adequate particle size for proper rumen development
- Should not be powdery or dusty as this will reduce intake

Figure 23. Offering calf starter from Day 1 encourages rumen development

In the first few weeks of life, calves only eat small amounts, but intake begins to measurably increase around 14 days of age.

- To avoid wastage, provide small amounts of fresh starter daily
- Observe calves to see when they require more starter

Forage feed

Forages are a good source of fibre, which promotes the growth of the muscular layer of the rumen and helps to maintain the health of the rumen lining.

In addition to starter, good quality forage should be offered as early as Day 3 on a 'little and often' basis to ensure freshness and encourage intake.

Feed racks and buckets should be positioned at a height that is suitable for calves and will reduce the possibility of soiling.

Figure 24. Feed buckets filled up to this extent have a high chance of feed spoilage

Water – an essential nutrient

Water accounts for 70–75% of a calf's body weight. Calves perform best when fresh drinking water is available to them from birth.

Why is water important for calves?

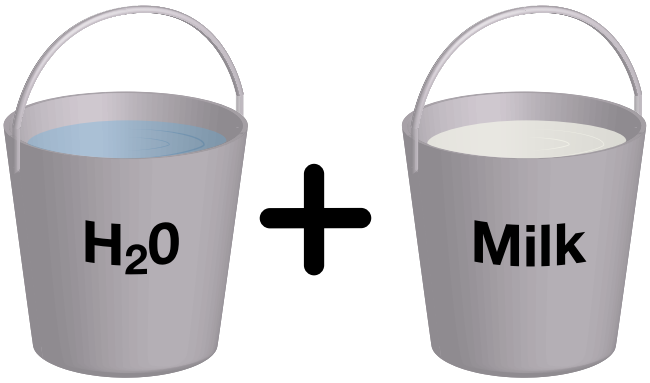
Water is fundamentally important to rumen development and the optimal growth of young calves.

- It is required to support the microbial population of the rumen and promote good rumen development and function

> ***Important***
>
> **All calves MUST be provided with fresh, clean water from birth.**

Fresh water should be provided in addition to milk or milk replacer.

- Providing water in addition to milk replacer can increase growth by 38% and starter intake by 31%
- Calves will drink 1 litre of water per day during the first week of life, increasing to nearly 3 litres by 3–4 weeks of age
- Providing warm water (16–18˚C) during cold weather may stimulate starter intake



Hot weather

In hot weather, particularly in temperatures above 25°C, the calf's water intake will increase to maintain hydration and normal body function.

Water quality and cleanliness

The location of the water supply must be considered to avoid contamination from faeces and spillage that would wet the bedding material.

Remove any feed or bedding from water sources daily and keep water buckets outside of pens to reduce spillage of water onto bedding (see Figure 26).

Scours

During periods of scours, dehydration will result in reduced feed intake, feed conversion and growth.

Scouring calves will consume greater volumes of water so must be provided with continual access to water.

Figure 25. Calves must always have clean water readily available to them 24 hours a day

Managing calves in cold weather

In cold weather, calves require more energy to keep warm. Calves must be fed with enough milk and concentrate to provide them with extra energy to maintain their body temperature, grow and remain healthy.

Lower critical temperature (LCT)

Temperature below which a calf needs extra energy to keep warm.

Feed is directed away from growth and the immune system to maintain warmth.

Newborn to 3 weeks of age

- Calves less than 3 weeks of age are the most vulnerable to changes in temperature
- The LCT for calves less than 3 weeks of age is 10–15°C and is highly dependent on airspeed
- Feed an extra 50 g of milk replacer or 0.33 litres of whole milk per day for each 5°C drop below 15°C

Calves older than 3 weeks of age

- The LCT for calves over 3 weeks of age is 5–10°C and is highly dependent on airspeed
- Feed an extra 50 g of milk replacer or 0.33 litres of whole milk per day for each 5°C drop below 10°C
- Calves should have continual access to starter feed

Figure 26. Keep water and feed sources outside of pens to reduce bedding spoilage

Table 5. Example of information found on a milk replacer label

Environmental temperature (°C)	Additional milk replacer (g/day)*		Additional whole milk (L/day)+	
	Birth to 3 weeks	3 weeks to weaning	Birth to 3 weeks	>3 weeks
20	0	0	0	0
15	0	0	0	0
10	50	0	0.33	0
5	100	50	0.67	0.33
0	150	100	1.00	0.67
–5	200	150	1.33	1.01
–10	250	200	1.67	1.33

*Based on a basic diet of 6 litres (900 g) of milk replacer with 18% fat and 22% protein containing 18.5 MJ/kg of ME, mixed at a rate of 150 g made up to 1 litre with water. +Based on a basic diet of 6 litres of whole milk containing 4.03% fat and 3.28% protein, 22.3 MJ/kg ME on a dry matter basis.

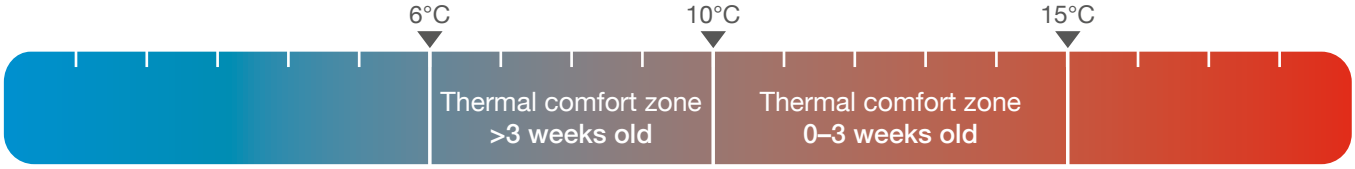


Figure 27. Thermal comfort zone of calves

To maintain desired growth rates during periods of cold weather, follow the guidance below.

Housing

- Monitor and record daily temperature in the calf shed using a min–max thermometer located at calf height
- Dry newborn calves to reduce heat loss
- Watch out for calves shivering or with raised hair
- Supply plenty of dry bedding material to allow the calf to nest
- Even in cold weather, calves need plenty of fresh air, but avoid draughts at calf level
- Reduce damp by providing adequate drainage
- In the presence of draughts or damp, calves will use more energy to keep warm

Figure 28. Draught excluder

Figure 29. Temporary housing adaptations, such as wind-breakers, can be an inexpensive way to protect calves at different times of the year

Feed and water

- Increase volume of milk or milk solids
- Use a milk replacer with a fat content of at least 18%
- Do not mix over 160 g of milk replacer made up to 1 litre with water because this will result in excessive mineral intake
- Provide fresh water at all times

Environment

The temperature the calf feels is a combination of temperature, airspeed and humidity.

Timing of feeds

Consider feeding milk to calves three times a day. The interval between milk feeds should not exceed 12 hours.

Table 6. Even in cold weather, calf housing needs plenty of fresh air. Draughts must be avoided at calf level

Airspeed at calf level (m/s)	Significance
0.15	Stale air – increases bacteria survival and pneumonia
0.2	Draught-free
0.3	Draught on calf – calf will become chilled

Table 7. The temperature the calf feels is a combination of temperature, airspeed and humidity

Age (weight)	Lower critical temperature °C at air speeds of:	
	0.2 m/s (draught-free)	2.0 m/s
Newborn (35 kg)	9	17
1 month (50 kg)	0	9

Source: Webster, 1981

Calf jackets

Calf jackets, coats or blankets can be used to help keep calves warm, dry and healthy when temperatures fall below 15°C. Before investing in these products, ensure your calves are receiving sufficient energy and have dry bedding to keep warm.

Considerations when buying calf jackets

- Breathable material that allows moisture on the calf's coat to pass through
- Water-resistant or waterproof
- Machine-washable – jackets must be washed after each use to reduce the risk of disease transmission
- Straps and fasteners – different types of adjustable straps and fasteners are available. Velcro will clog and requires additional cleaning and maintenance. Simple, plastic clips are preferable. Check with the supplier that replacements are available

Management tips

1. Monitor temperature in the calf shed daily.
2. Agree a protocol with the farm team to include the temperature at which calves will start to experience cold stress.
3. Calves less than 3 weeks are most vulnerable to extreme temperatures; therefore, prioritise these if the temperature is below 15°C.
4. Calves older than 3 weeks may not need a jacket unless the temperature is below 5°C.
5. Only put jackets on dry calves. Wet calves must first be dried thoroughly until they have a dry, fluffy coat.
6. Only use dry and clean jackets. Dry jackets provide better insulation and avoid trapping moisture beneath them. Using clean jackets reduces the spread of disease.
7. Be sure the jacket fits snugly to the calf so it covers the calf's body from neck to tail.
8. Adjust straps weekly as the calf grows.
9. To preserve body heat, ensure calves have enough dry bedding to nest.
10. Monitor jackets for cleanliness and replace a soiled or wet jacket with a clean, dry one.
11. Removal of jackets will depend on the weather as well as the condition and appetite of each calf. Remove jackets in the morning.
12. Remove dirt from jackets with a hose or light power-wash. If necessary, pre-soak.
13. Wash jackets according to manufacturer's instructions and leave to dry completely between uses.

For further details on *Cryptosporidium*, see the section on page 27.

Monitoring calves

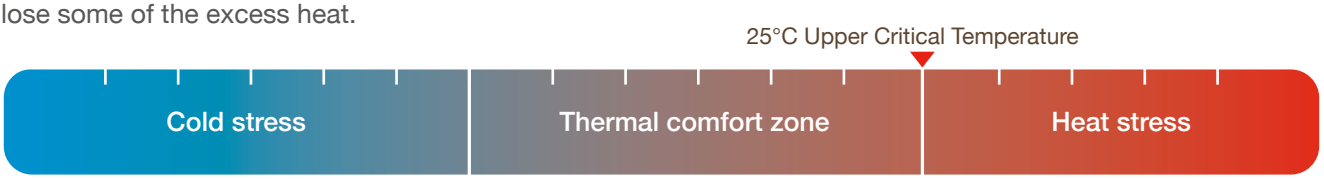
- Monitor growth using a weigh scale, weigh band or height stick
- Check calves at least twice a day
- Record and monitor early signs of illness: discharge from eyes or nose, cough, dirty hindquarters and scour (see page 30 for more information)
- Discuss calf health with vet

Bedding tips

- When nesting, the calf's back legs should not be visible
- Dry bedding will keep jackets relatively clean and dry
- While sand, sawdust or shavings are suitable bedding choices for the summer months, these are poorer choices for winter use because they do not provide the calf with any thermal protection
- Straw is the ideal bedding for use in winter

Managing calves in warm/hot weather

At temperatures above 25°C, calves will become heat-stressed. To counter this, they start to sweat to lose some of the excess heat.



Heat stress – the calf

- At environmental temperatures above 25°C, the calf's body temperature will rise
- To keep cool, calves will:
  - Breathe quicker
  - Drink less milk and eat less
  - Drink more water
  - Spend longer standing and less time lying
- To aid cooling, energy is diverted to maintain core body temperature, making less energy available for growth
- The immune system is suppressed, which reduces the calf's ability to fight disease

Maintaining growth rates during warm weather

- Invest in a thermometer for the calf accommodation
- Monitor temperature daily, at the calf level, in the calf housing
- Check for any calves sweating, panting or drinking excessively. If monitoring rectal temperatures, heat-stressed calves are those with a rectal temperature of above 39.4°C
- Feed extra energy by increasing volume of milk or concentration of milk solids
- Keep water out of direct sunlight and change often
- Reduce stocking rate
- Increase airflow into the building but avoid draughts at calf level
- Provide shade so calves can move out of direct sunlight to avoid overheating
- Control flies to reduce the risk of disease spread
- Avoid locating water troughs/buckets over bedding so that it does not become wet. Figure 30 shows a situation that should be avoided

Roof lights

Roof lights are beneficial for reducing the need for artificial lighting, thus reducing lighting costs. However, they can increase heat in a building when fitted on the south-facing aspect. To avoid overheating, roof lights should be fitted to north-facing aspects of the building.

Figure 30. Avoid locating water troughs/buckets over bedding

Temperature rises

Remember that when temperatures become warm enough for you start to sweating, calves will also sweat. In summer, take steps to help calves to cope with the heat.

Remember the basics

- Offer plenty of water at all times
- Replace starter daily to keep it fresh
- Clean and disinfect water and milk-feeding equipment daily. Warm weather promotes growth of algae, mould and bacteria

Important

High humidity and poor airflow in a well-stocked building can result in heat-stressed calves, even in cooler months.

Further information about colostrum hygiene, along with other calf management materials, can be found online at **ahdb.org.uk**

Successful calf weaning

Changes in diet, environment and social grouping can make weaning a stressful time in a calf's life. A successful weaning programme will reduce stress and disease and ensure minimal disruption to growth rates.

When to wean

Healthy calves should be weaned based on concentrate intake and not on weight, size or age.

- Research shows that, provided calves are at least 5 weeks of age, concentrate intake is the key factor on which the decision about when to wean should be based
- From a nutritional perspective, the most suitable time to wean a calf is when it is consuming enough concentrate. Concentrate intake is a good indicator of rumen development

The recommendation is to wean calves eating, for three consecutive days, at least:

- **1 kg if calf starter is >22% crude protein or;**
- **2 kg if calf starter is <22% crude protein**

Calves weaned before 5 weeks of age tend to be more susceptible to disease.

Only wean healthy calves that are growing well. Delay weaning for ill calves or for those with poor intakes.

Water

Clean, fresh, ad-lib water must be provided from birth to encourage rumen development and concentrate intake and to increase daily weight gains.

How to wean

- Weaning should be done gradually by reducing milk over a period of 7–14 days
- This will lead to increased concentrate intake, avoid a growth check after weaning and minimise weaning distress
- Reducing milk can be achieved by:
  - Reducing the volume of milk fed per feed
  - Reducing the number of feeds per day

Reduce stress at weaning

Stress at weaning can compromise calves' immune systems for at least 2 weeks after weaning. This can make calves more susceptible to disease, particularly pneumonia, and can compromise growth.

Make no changes to housing, feed, water or social groups for the 2 weeks after weaning.

Avoid stressful procedures at weaning such as vaccination, disbudding and castration.

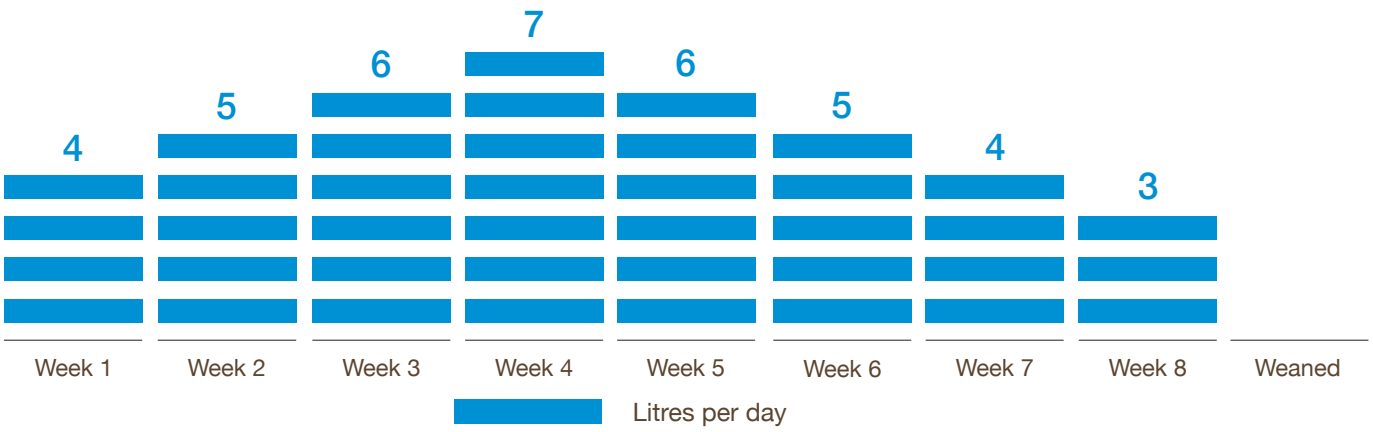


Figure 31. Examples of volume of milk replacer fed up to weaning

Notes: This is based on the animal consuming 0.75–1 kg of concentrate and having access to ad-lib water to meet its nutritional requirements.

Monitoring growth

Measuring the growth rate of youngstock provides useful information about how well they are growing. It is also an indirect method of monitoring the efficiency of feed conversion. Meeting growth rate targets ensures maximum return on your investment.

Benefits of monitoring growth

- Achieve target growth rates for breeding
- Identify underperforming and sick calves
- Identify problems within your system (e.g. suboptimal environment)
- Maximise growth efficiency cost-effectively

Top tips

Growth is at its most efficient in the first 2 months of life, so high growth rates should be targeted during milk feeding.

Monitoring growth from birth can guide continual management improvements to ensure that every heifer is in calf by 15 months of age.

Monitoring growth by weight or height

Weight

Electronic scales are the most accurate method of determining weight.

A set of weight bars with a strong platform will suffice. Using this in combination with a race will be good training for handling in later life.

A weigh band can be used to estimate weight.

This is placed around the calf's chest, behind the front leg and shoulder blade – it must be placed flat against the skin and held at a consistent tightness, ensuring it is not twisted.

Height

Height can be measured using a height stick placed across the withers or rump while the animal is standing on a flat surface.

Alternatively, make use of fixed height markers on the wall of the rearing building. If these are used, it is important to account for any change in bedding height that may occur.

When

A growth rate can only be calculated when at least two measurements have been made.

The calf's birth weight should be recorded because this will provide a baseline figure against which to calculate the average daily gain, ADG (also known as daily liveweight gain, DLWG).

Then again, as regularly as possible, including:

- Weaning
- 1 week post-weaning
- 6 months of age
- At breeding

Taking a measurement at 6 months of age allows time for corrective measures prior to breeding.

ADG calculation

$$\text{ADG} = \frac{\text{last recording} - \text{earliest weight recording}}{\text{Number of days between weighs}}$$

Example

A calf has a birth weight of 36 kg. At weighing 1 month later, it weighs 62.5 kg. Use the average daily gain calculation to work out the daily gain for this calf.

$$\frac{62.5 - 38}{31} = 0.70 \text{ kg per day}$$

Targets

The key to successfully rearing heifers for a 24-month calving is to maximise weight gain without creating overfat heifers.

Research and experience confirm that heifer growth rates are best set as a percentage of mature weight or size.

It is important to base your targets on a percentage of mature size (weight or height) of several third and fourth lactation cows, 100–120 days in milk within the herd.

Remember, it does not matter which method you use to monitor growth, as long as you take regular measurements from your own animals using the same method each time. This allows you to benchmark your herd performance between groups. Table 8 provides guidance on the percentage mature weight to target at regular intervals. For your farm, decide the most appropriate intervals and therefore when to weigh your heifers.

Example

For a herd with an average mature body weight of 685 kg, the target growth rate at different stages of growth is set out in the table below.

If you find that growth rates overall are too low, consult your nutritionist or vet for advice.

For more information on calf management, please visit ahdb.org.uk

Table 8. Target weight gains depending on age of calf with a minimum average growth rate of 0.8 kg/day and target mature weight of 685 kg

Age	Stage	Body weight (kg)	% Mature weight	% Mature height
0	Birth	41	6	
1		55	8	
3	Post-weaning	116	17	63
6		185	27	74
9	Puberty	274	40	
12		343	50	
14	Pre-breeding	377	55	87
24	Pre-calving	582	85	96
MW	Adulthood	685	100	

Note: Weighing calves at 12 months gives a good opportunity to check whether the animal is on target. If they are underweight, there are 2 months to catch up before breeding.

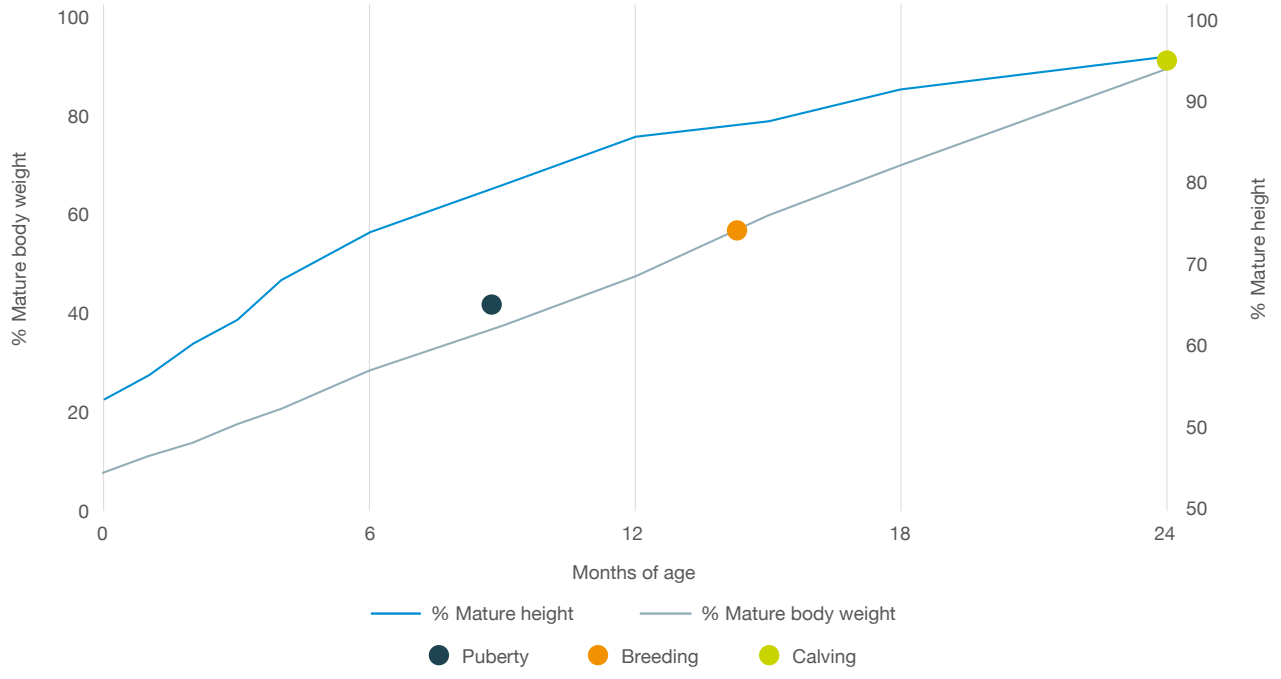


Figure 32. The target percentage differs for body weight and height, as shown in the graph above

Controlling cryptosporidiosis

What is cryptosporidiosis?

Cryptosporidiosis is one of the most common causes of calf scour. Calves are usually infected with the *Cryptosporidium* parasite shortly after birth and develop scour at around 5–7 days old. Four *Cryptosporidium* species are capable of infecting cattle; however, the main disease-causing species is *C. parvum*. Humans can also be infected with *Cryptosporidium* when handling infected cattle.

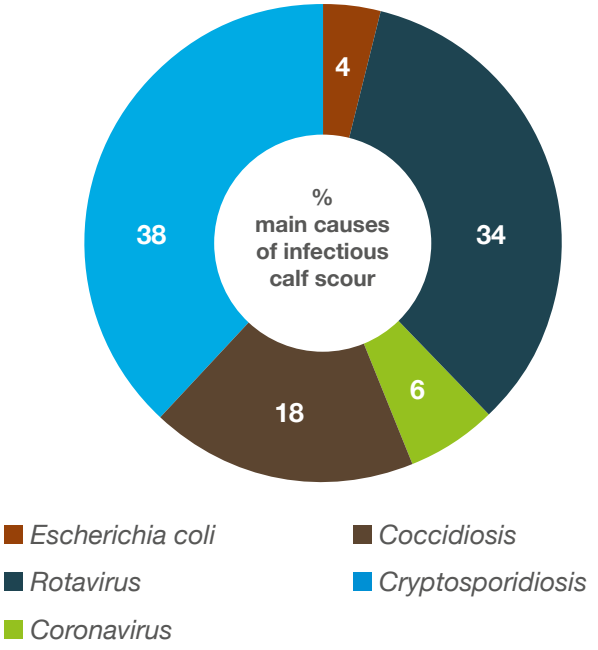


Figure 33. Main causes of infectious calf scour

Signs of cryptosporidiosis

The main signs of cryptosporidiosis include watery scour, dehydration and reduced feed intake. Suckled calves will also cease sucking and may lay separately from the rest of the herd.

Where do calves get *Cryptosporidium* from?

Large numbers of eggs are shed in the faeces of infected calves and cows, which contaminates the environment. Ingesting egg-contaminated food or water causes calves to become infected. Eggs can be found in bedding, pasture, soil and water. Infected calves shed up to 1 million eggs per gram of faeces and it takes only a small fraction of this number to cause disease.

Farmers and stockpersons can also be potential sources of infection, so it is important to have good hygiene procedures in place, such as insisting that footwear is cleaned at the farm entrance and before entering calf accommodation. It is also important to provide clean clothing or overalls when trying to prevent the spread of the disease.

The lifecycle

Once ingested, the parasite attaches to the gut wall and multiplies. This causes damage that reduces the calf's ability to digest food, resulting in watery scour.

While attached to the gut wall, the parasite produces eggs. These are infectious and can either re-infect the calf or be shed into the environment from the infected calf's scour.

Symptoms of the disease appear 3–5 days after infection. Following infection, a calf can shed the eggs for 2 weeks or longer.

Calves can begin shedding eggs in their faeces as early as 2 days of age, which means they are susceptible to infection shortly after being born.

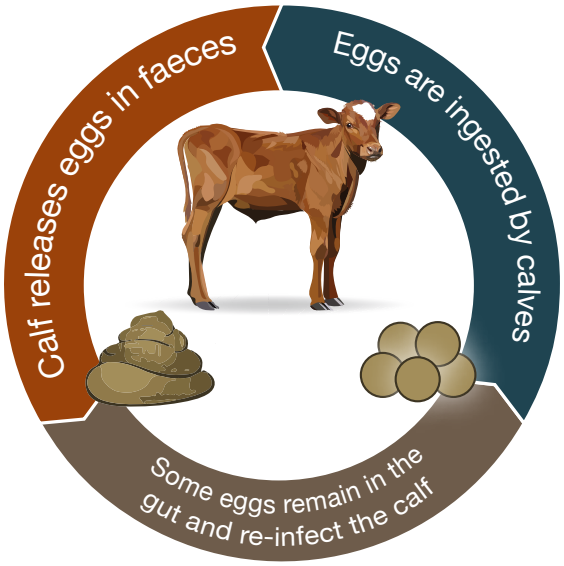


Figure 34. *Cryptosporidium* lifecycle

Take action

1. Diagnosis

Diagnosis is made by identifying *Cryptosporidium* eggs in faeces. If you have scouring calves, consult your vet to get an accurate diagnosis because treatments differ depending on the pathogen(s) involved.

2. Environmental control: clean and disinfect

- Keep the area where calves are born clean
- Muck out, steam-clean and disinfect as frequently as practical
- Let pens dry because ***Cryptosporidium*** does not like dry conditions
- Turn spring-calving sucklers out as soon as possible after calving. When housing autumn calvers, keep the environment dry and clean throughout the winter. Use lime to help keep bedding dry
- Rodent and fly control should be in place and all feed and grain should be stored in covered areas, away from rodents and pets

Use *Cryptosporidium*-effective and licensed disinfectants (KenoTMCox, hydrogen peroxide, Neopredisan, Ox-Virin). Many common farm disinfectants are NOT effective against *Cryptosporidium*.

Always follow manufacturing guidelines.

3. Implement the 3 Qs of colostrum

Quickly, Quantity and Quality. See page 4 for full information on feeding colostrum and hygiene best practice.

4. Animal control

- Control all pathogens that cause scour in young calves
- Use disinfectant at the entrance to calf shed
- Vaccinate pregnant dams against rotavirus, coronavirus and *E. coli*, thereby reducing scours caused by these pathogens
- Do not mix older calves with young calves because older calves may still shed eggs
- Keep all calves warm and hydrated, particularly if they are scouring
- Isolate scouring calves from healthy calves. Do not mix scouring calves with healthy calves for at least 1 week after scouring has ceased
- Feed and deal with healthy calves before sick ones
- Use separate, dedicated feeding equipment for sick calves

Important

Calf jackets can potentially harbour Cryptosporidium eggs. These eggs can only be destroyed if the jackets are treated with a licensed Cryptosporidium disinfectant (consult data sheet for recommended contact times), then washed according to manufacturer's instructions and left to dry completely. See page 22 for full information on calf jackets. Please note: Cryptosporidium eggs are only destroyed at temperatures above 60°C.

5. Prevent and treat

- Rehydration of infected calves is key for survival. Feed 2 litres of oral electrolytes 2–4 times a day. Continue to offer scouring calves normal amounts of milk or milk replacer, as long as they want to drink. Give suckler calves access to their dam at all times; if they have stopped suckling, feed the calf via a teat or stomach tube if possible
- Use a licensed product to both prevent and treat cryptosporidiosis to reduce egg secretion and the severity of calf scour
- For prevention, dose all newborn calves within the first 24–48 hours of life
- For treatment, dose all calves within 24 hours of diagnosis. Ensure dehydrated calves are fully rehydrated before treatment

For both regimes:

- Accurate dosing is essential
- Dose orally after feeding for seven consecutive days

The healthy calf

The aim of every calf and youngstock rearing unit should be to rear healthy animals with minimal mortality and optimal growth rates. A healthy calf, in a warm and dry environment, has the best chance of achieving its full lifetime potential. It is:

- More likely to survive
- More productive
- More profitable

A healthy calf uses its feed more efficiently. Calves use their feed in many ways. First, they must maintain their normal body functions, then they use energy to keep themselves warm and fight disease and finally, energy left over can be used for growth (Figure 35).

All calves need energy for maintenance (e.g. digestion, respiration). A healthy calf in a warm, low-disease environment has more energy available for growth.

A sick, cold calf has the same maintenance requirement, but needs almost all of its remaining energy to keep warm and fight disease. These calves grow very slowly and inefficiently (Figure 36).

Identify common problems early

More than half of calves on UK farms suffer from disease before weaning and nearly all of these diseases are scours and respiratory disease.

With such a high incidence of scours and respiratory disease, it can be easy to accept the early signs of disease as 'normal' (e.g. it is not normal for calves to be coughing).

It can also be easy to miss calves with mild disease and to only identify and treat the really sick ones – especially in group housing. Even mild disease takes energy away from growth and can limit the animals' lifetime potentials.

Don't let ill health become normal

Identify and act at the first signs of problems. Identifying common problems early gives you the chance to:

- Reduce the severity and duration of the disease
- Reduce the risk of irreversible damage (e.g.lung damage)
- Reduce harmful bugs in the environment
- Reduce the spread of disease

1. **Check calves at least twice a day – are your calves healthy?**
2. **Identify common problems early – use the chart overleaf.**
3. **Record and monitor early signs of disease.**
4. **Treat if necessary – in accordance with your vet.**
5. **Make preventative or corrective measures.**

Don't leave it too late. Remember, going off milk is a late sign of disease.

The ***Calf rearing notebook***, produced by AHDB, provides an easy format to record calf and colostrum intake, weight and medicine records.

Figure 35. Energy expenditure by a healthy, warm calf – ideal

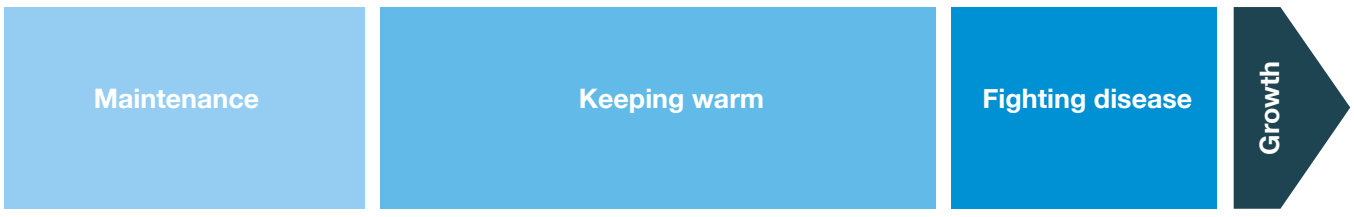
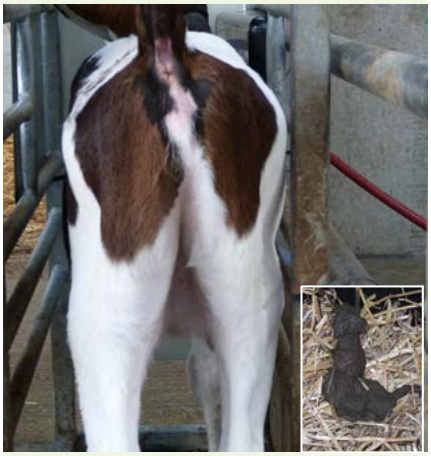


Figure 36. Energy expenditure by a sick, cold calf – inefficient

	SIGNS OF GOOD HEALTH AND VIGOUR • Bright • Playful • Curious • Keen to drink milk	LOOK FOR EARLY SIGNS OF DISEASE • Quiet • Slow to stand • Still drinking milk	LATE SIGNS OF DISEASE • Dull • Reluctant to stand unaided • Off milk
RESPIRATORY	  • Clear eyes and nose • No cough Normal temperature (38–39°C or 100–102°F)	  • Discharge from eyes and nose • Cough on movement High temperature (>39.5°C or 103°F)	  • Severe discharge with pus • Frequent coughing/wheezing High temperature (>39.5°C or 103° F)
SCOURS	 • Clean hindquarters • Well formed faeces Normal temperature (38–39°C or 100–102°F)	 • Dirty hindquarters • Loose faeces Variable temperature	 • Wet hindquarters • Hair loss • Dehydrated • Watery faeces Variable temperature

ACT NOW

Implement the treatment plan agreed with your vet

Information supplied by Volac.

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