Calf management

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Introduction

Calves are the future of the cattle herd and deserve to have the best management, incorporating the latest research and advice. The aim of calf rearing is to produce strong, healthy, well-grown dairy and beef calves that will continue to develop steadily after weaning. The way we care for our calves can have a major and long-lasting effect, not just at the farm level, but throughout the industry, where issues such as animal welfare, disease and food safety can have significant consequences.

Every day, farmers make decisions that can affect the health and welfare of their calves. With the best decisions, they will repay the investment through higher production and a longer productive life. 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 at least their second lactation. Similarly, beef calf production has high production costs. With high-quality care it is possible to achieve optimum growth rates. In both dairy and beef businesses, nutrition during the rearing period is related to lifetime performance and health of the calf.

By following several processes from birth, you can make sure that every calf has the best possible start to life. Calves that are well cared for have a reduced risk of disease and cost less to rear. Also, they grow faster and go on to be stronger well-grown replacements that continue to develop into valuable, productive adults. It can make the whole farm team's life easier and more rewarding.

This new edition of the Calf management guide has updated information based on the latest science and developments in calf husbandry and nutrition. It is designed to integrate with other AHDB calf-rearing resources, such as our Youngstock housing guide, Calf health scorecard, and online videos and case studies.

It is hoped that this edition of Calf management will help farmers and calf rearers build on their skills and knowledge.

Dr Jenny Gibbons
Senior Animal Health & Welfare Scientist

Key messages

- Newborn calves should receive at least 3 L of colostrum within the first 2 hours of birth, followed by a further 3 L within 12 hours of birth
- Test colostrum quality using a Brix refractometer to ensure colostrum is at least 50 g/L of antibody (IgG) or 22% on the Brix refractometer
- Feed sufficient milk or calf milk replacer to support target growth rates and the development of the immune system
- Forage and good quality concentrate should be provided from day one
- Provision of fresh, clean water is essential from birth
- Calves should be weaned only once they are consuming sufficient concentrate feed
- Be aware of the impact of both cold and heat stress on energy requirements and take steps to minimise the impact of this on calf health and performance
- Good hygiene is vital in reducing the risk of disease
- Regularly monitor growth rate by weighing or measuring height at birth and then 1 week post-weaning, at 6 months of age, and at 12 months

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The three Qs of feeding colostrum

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

Calves that absorb sufficient immunoglobulins in the correct time frame after birth are significantly healthier with a higher rate of survival. Calves which fail to get adequate transfer of immunity from colostrum are 1.5 times more likely to get scour, 1.8 times as likely to get pneumonia and twice as likely to die. Research carried out in GB showed that some calves are at greater risk of receiving an insufficient quality and quantity of colostrum quickly enough. These include:

- Bull calves
- Twin calves
- Calves born to a heifer
- Calves with assisted delivery
- Calves born from cows with poor energy balance prior to calving
- Calves needing assistance with colostrum feeding

Remember the three Qs

- Quantity – a minimum of 3 L (for an average-sized calf) at the first feed and 6 L in total within 12 hours
- Quality – contains at least 50 g/L of IgG and is of good hygienic quality
- Quickly – the first 3 L within 2 hours of birth, then the second feed before 12 hours

Quality

Good quality colostrum contains at least 50 g/L of IgG. Any colostrum containing <35 g/L of IgG should not be used. It is not possible to determine the quality of colostrum by looking at it: it must be tested – use a BRIX refractometer.

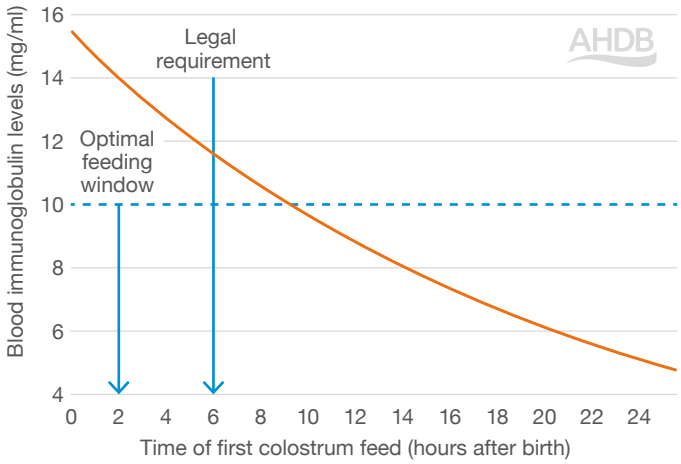
Colostrum over 22% BRIX is good first-feed colostrum; between 18–22% likely requires supplementation; below 18% is not suitable for first-feed. Test colostrum from all cows and ensure cows are milked as soon as possible after calving so that the best possible colostrum is collected and fed to newborn calves. The antibody content of colostrum reduces significantly with an increasing time interval between calving and milking. Antibody absorption in the small intestine is inhibited by bacterial contamination of colostrum. Therefore, hygienic collection, storage and administration of colostrum is essential.

Quantity and quickly

The recommendation is to give a first feed of a minimum of 3 L within the first 2 hours after birth to optimise immunity. 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.

Calves' ability to absorb antibodies from colostrum reduces rapidly from the time of birth and continues to reduce after the first feed. The ability to absorb also reduces when bacteria start to colonise the intestines, which is why calves must be born into a very clean environment and be fed hygienic colostrum from clean equipment.

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. The colostrum should ideally be fed at a body temperature of 38°C. Feeding colostrum to calves over several days is beneficial for building immunity and fighting infections.



Source: AHDB

Figure 1. The optimal feeding time for colostrum is within 2 hours of birth. Colostrum quality declines after 6 hours and the calf's ability to absorb antibodies (IgG) is dramatically reduced. After 10 hours, the calf's ability to absorb enough IgG is dramatically reduced, and by 20 hours, this ability is nearly gone

Method of feeding

Calves left to suck their dam are 2.4 times less likely to receive sufficient antibodies. Around half of calves left to suck do not have good passive transfer of antibodies (immunity), so feed the calf by either:

- Bottle – promotes transit of the colostrum direct to the abomasum (true stomach). 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 L
- Tube feeding – ensures that the calf receives the full volume of colostrum but delays the time taken for colostrum to reach the site of antibody absorption (in the small intestine). Tube feeding is a skilled technique that can only be undertaken safely by trained staff

Tube feeding colostrum to calves

If a calf is unable to suck a bottle or consume the full amount of colostrum, then an oesophageal feeder (sometimes referred to as a stomach tube) should be used. This is a skilled technique that requires training to ensure the correct placement of the tube. Once this technique is mastered, it can also be used to give electrolyte fluid to dehydrated calves and older animals.

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

How to tube feed colostrum

Before feeding any colostrum to the calf, make sure the feeding tube has been thoroughly cleaned and disinfected and is in good working order – sharp edges or disintegrating rubber can harbour bacteria and may damage the calf's mouth.

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, and if carrying out this task within the calving pen, be aware of the cow's maternal instinct to protect her calf.

Inserting the tube

1. Before inserting the tube into the calf's mouth, moisten the tube with warm water or colostrum, and 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.
2. Holding the calf's head in a natural position, slowly pass the tube over the tongue to the back of the mouth.
3. 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. The windpipe is a harder structure with rings obvious to the touch, while the oesophagus is a softer, collapsible structure.
4. When the tube is in the correct position, it can be felt in the oesophagus on the left-hand side of the calf's neck. Stop immediately if you feel any resistance or if coughing occurs (which is likely to indicate that the tube has entered the windpipe) – pull the tube out slightly and redirect. The tube should never be forced.
5. When the tube is in the correct position, the calf should be comfortable and swallowing.

Important

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

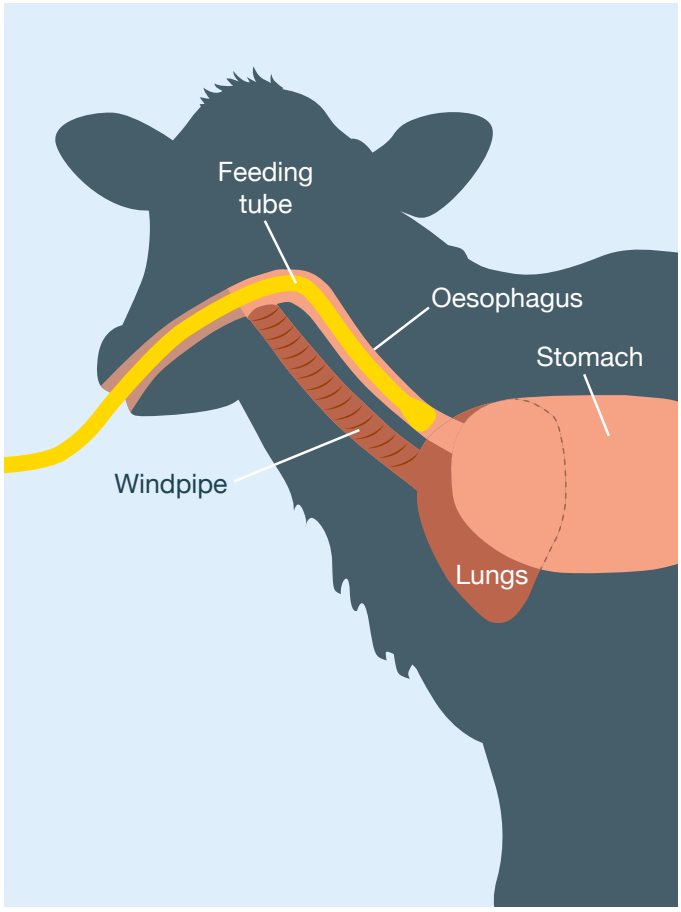


Figure 2. Diagram of correct placement of a stomach tube via the mouth

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 a body temperature of 38°C. Control the flow rate of the colostrum; a slower flow rate will be more comfortable for the calf and minimise the risk of 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. Removing the tube prematurely, while there is still liquid in the bag/tube, may cause colostrum to enter the lungs. 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.

Testing the quality of colostrum

Testing colostrum helps you to make an informed decision as to whether the colostrum is good enough quality to be fed or stored or needs to be discarded. There is no way of assessing colostrum quality by eye – density and colour are not accurate indications of antibody content.

Good quality colostrum contains at least 50 g/L of IgG. Any colostrum containing <35 g/L of IgG should not be used. The IgG content of colostrum can only be accurately tested using laboratory techniques. However, there are cow-side tests which can be used to give an estimation of IgG content – the preferred method is to use a BRIX refractometer.

Using a BRIX refractometer

1. Ensure the refractometer is free from any visual dirt, and check for any cracks or breaks in the glass.
2. The refractometer should be calibrated before every use. Put 2–3 drops of distilled water on the glass surface.
3. Lower the cover over the sample so the water spreads across the entire surface without any air bubbles or dry spots.
4. Wait 15 seconds before taking a calibration reading – this allows the sample to adjust to room temperature.
5. Hold the refractometer up to natural light while looking down the eyepiece. Avoid fluorescent light sources.
6. 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.
7. Wipe the surface clean with a clean soft cloth.
8. Once dry, place a couple of drops of colostrum onto the glass surface and repeat the process.
9. Take a reading on the BRIX scale as an approximation of the antibody content of the colostrum.
10. When you are happy with the reading, ensure you clean the slide and glass ready for next time.

Figure 3. A droplet of colostrum is placed on the BRIX refractometer

Understanding BRIX refractometer results for colostrum quality

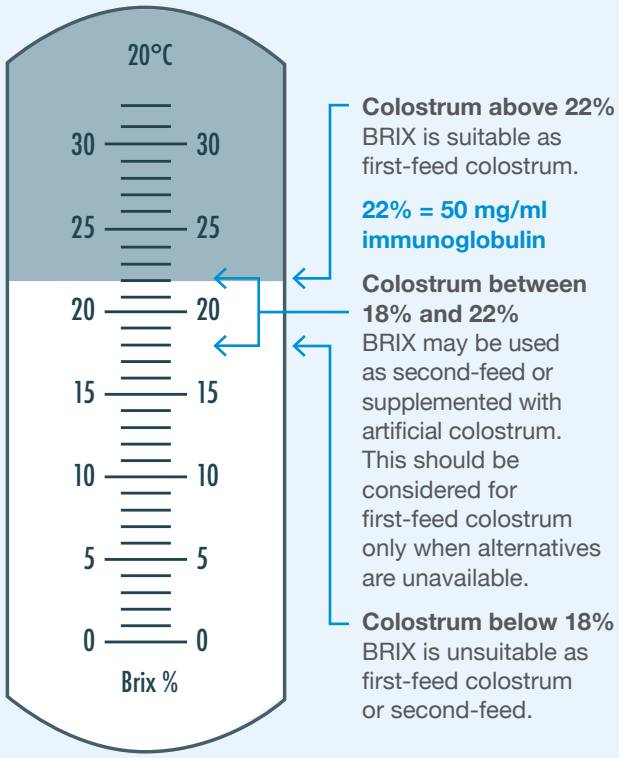


Figure 4. Brix refractometer: 0–32% scale

Are your colostrum protocols effective?

Regular monitoring of the effectiveness of colostrum management is recommended for all farms and is an essential first step for any farm struggling with calf health or performance. Blood samples can be taken from young calves (usually <10 days of age) to determine the adequacy of the transfer of antibodies via colostrum. Laboratory testing determines actual antibody content in the blood, whereas quicker, 'cow side' tests use total protein as a proxy for antibody content. A minimum of 12 calves should usually be sampled when making decisions about whether herd-level protocols are effective.

Speak to your vet about testing on your farm.

Colostrum hygiene

The hygienic quality of colostrum is crucial in ensuring that a calf absorbs adequate antibodies from the colostrum. Bacterial contamination of colostrum directly reduces the absorption of IgG in the small intestine and speeds up the closure of antibody absorption sites. This reduces calf immunity as well as having the potential to introduce pathogens. Good hygiene during the collection, transfer and feeding of colostrum is essential in reducing bacterial contamination.

Collecting colostrum

Know the disease status of your cows. Do not use colostrum from cows that have tested positive for Johne's disease or are suffering from post-calving disorders, e.g. mastitis.

Ensure udder cleanliness. An effective teat disinfection routine should be used to remove bacterial contamination of teats. Pre-stripping should be carried out to remove any teat sealant.

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

Ensure that colostrum harvesting equipment is cleaned and disinfected prior to use – use scalding hot water and hypochlorite or peracetic acid for disinfection.

Use a clean bucket for harvesting colostrum and ideally transfer the colostrum immediately to a clean feeding vessel. If colostrum is to be stored prior to feeding, it should be transferred to a bucket/container with a lid.

Storing colostrum

In warm colostrum, bacterial numbers can double every 20 minutes, but bacteria continue to multiply even when colostrum is stored in the fridge.

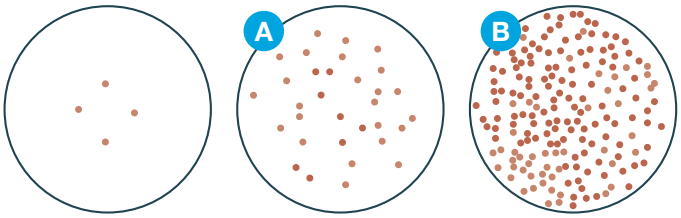


Figure 5. A) Bacteria after 1 hour, B) Bacteria after 2 hours

Fresh colostrum should be fed to calves within 1 hour of collection or stored appropriately. There are three ways to help reduce the rate of microbe multiplication: refrigeration, freezing and pasteurisation. 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.

Table 1. Colostrum storage methods

	Refrigeration	Freezing
Maximum length of storage	24 hours	Up to 1 year
Storage method	1–2 L containers	1–2 L zip bags
Storage temperature	4°C	-18 to 20°C

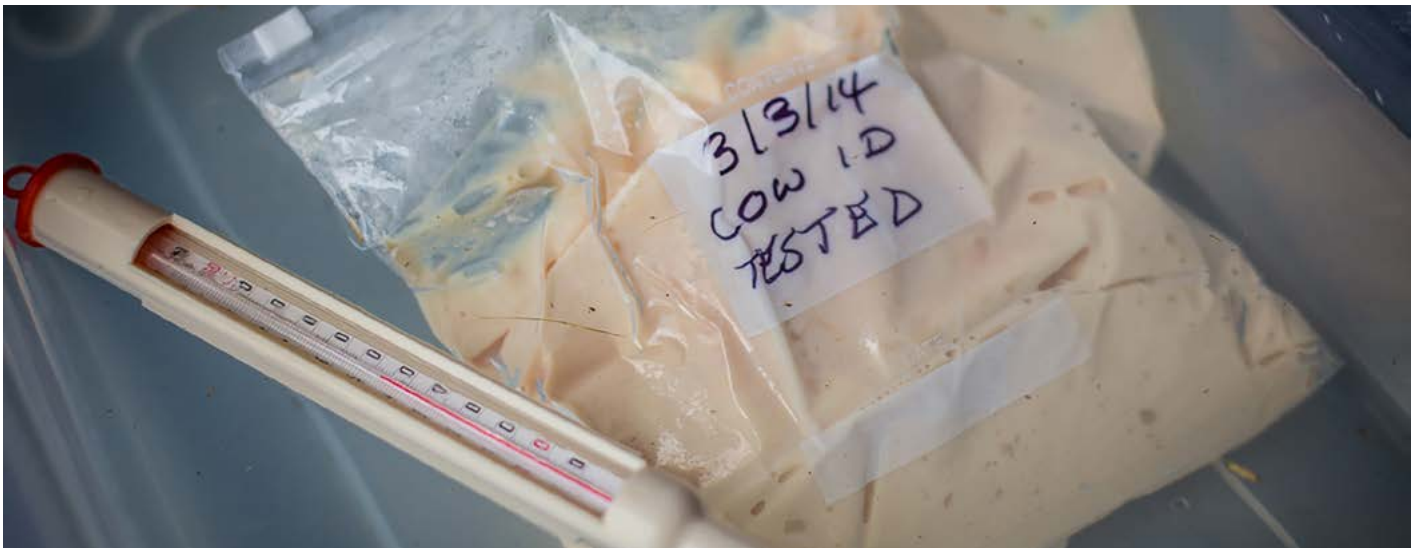


Figure 6. Colostrum should always be tested, bagged and labelled if stored

Pasteurising colostrum

Pasteurisation is not a storage method but a way to reduce the number of bacteria present – it does not remove bacteria completely. The remaining bacteria will begin to multiply again after pasteurisation is complete. Therefore, pasteurised colostrum must still be chilled or frozen if not being fed immediately. Pasteurisation does not make low-quality or highly contaminated colostrum fit to feed. If using a pasteuriser, refer to the manufacturer's instructions with regard to batch quantities and servicing procedures. Pasteurisation cannot be relied upon to prevent infection with Johne's disease, especially from milk from test-positive cows.

Feeding stored colostrum

Remember, colostrum should be fed at a body temperature of 38°C. 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. Check the temperature using a thermometer, and once warmed, use within 30 minutes. Frozen colostrum can be thawed in the refrigerator overnight or in a warm water bath (maximum 50°C) before warming to 38°C.

Important

Do not use a water bath hotter than 50°C or use a microwave to reheat or thaw colostrum because this will denature the antibodies.

Hygiene testing

The hygienic quality of colostrum can be tested in a laboratory and is recommended for farms struggling to achieve adequate passive transfer of immunity. Samples should be taken just prior to feeding to the calf. Targets for good hygienic quality are:

- Total bacterial content <5,000 cfu/ml
- Coliform count <20 cfu/ml

Speak to your vet for more information about testing the hygienic quality of colostrum.

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

Using a water bath with a thermometer, as pictured above, is a good way to thaw colostrum.

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

Sourcing calves

For units which do not breed their own calves, successful calf rearing begins with sourcing the correct calves for the system. It is important calves have the best start in life, as disease in the early stages can have long-term impacts on performance.

Buy calves that are:

- Known to have received adequate colostrum at birth
- Of known disease status, particularly with respect to Bovine Viral Diarrhoea (BVD) virus
- Seven days old or more
- Well-grown for their age
- Healthy with a dry navel
- Alert
- Showing acceptable conformation

Checks on arrival

Transport from the farm of origin to a rearing unit can be a severe cause of stress to young calves, which can increase the risk of disease. It is important to take steps to minimise stress where possible.

1. Calves frequently become dehydrated during transport, so offer calves 2 L of warm electrolytes on arrival through a teat or automatic feeder.
2. Milk can be introduced at the next feed.
3. Where other cattle are on the farm, new arrivals should be quarantined for seven days, and they should be observed for signs of disease.
4. If their BVD status is unknown, calves should be tested for BVD antigen to identify any persistently infected (PI) animals.
5. Wait a few days before considering disbudding or castrating calves, as this will add further stress.

Persistently infected BVD status

Persistently infected cattle have a high likelihood of dying in their first year. Their growth rates are typically lower than healthy counterparts, and they can weaken the immune system of calves around them, making them more vulnerable to other infections. The incidence of pneumonia can increase by 43% in healthy cattle sharing air space with a PI. Calves identified as being PI should be culled immediately because they will shed high quantities of BVD virus into their environment for life.

Further information about BVD and BVDFree England can be found at **bvdfree.org.uk**

Transport regulations for calves

- Do not transport calves:
  - With an unhealed navel
  - Less than 10 days of age (unless less than 100 km)
  - To market more than once within 28 days
  - For journeys over 8 hours if less than 14 days
- Unweaned calves must be fed after 9 hours travel and given a 1 hour break, after which they may be transported for a further 9 hours, before resting for at least 24 hours
- Ramp angles must be less than 20 degrees on decked vehicles
- Deck height must allow the calves to stand fully and still be able to walk in and out independently
- Transporters must have a minimum space allowance of:
  - 0.3 to 0.4 m^2 per calf for calves under 50 kg
  - 0.4 to 0.7 m^2 per calf for calves between 50–110 kg
  - 0.7 to 0.95 m^2 per calf for calves between 110–200 kg
- You must not transport any calf that is:
  - Ill, sick or injured
  - Unable to move independently without pain or to walk unassisted

If in doubt, seek veterinary advice.

See **gov.uk/guidance/animal-welfare** for more information.

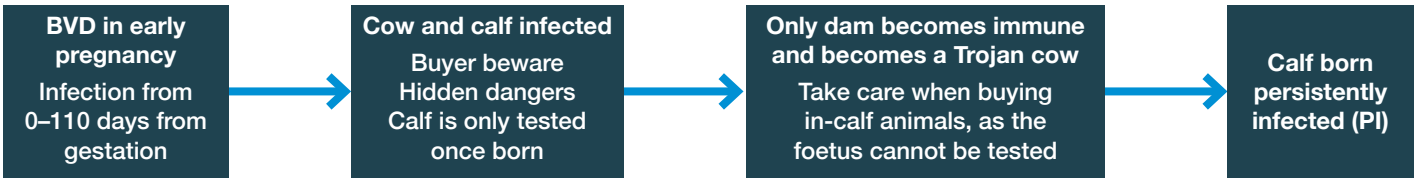


Figure 7. How a PI calf is created

Milk feeding – raw whole milk or milk replacer?

Important

It is a legal requirement to feed calves under 28 days of age at least two liquid feeds a day.

Using milk produced on farm

Raw whole milk is typically 32% fat, 26% protein and 36% lactose on a dry matter (DM) basis. This is much richer in nutrients than traditional milk replacers. However, if considering feeding raw whole milk, the potential implications for disease risk must be considered in consultation with your vet.

Suitable milk

When feeding whole milk, it is important the herd's health status is fully understood. Feeding raw whole milk is a potential route of transmission for Johne's disease, and it can also contain the pathogens responsible for tuberculosis (TB), BVD, Mycoplasma and Salmonella.

Milk from cows which have tested positive for Johne's disease, or are suspected to be infected with these diseases, should not be fed to calves. Do not feed waste milk (antibiotic-treated, mastitic or high cell count) to calves. Feeding waste milk to calves has been shown to increase the risk of disease (particularly scour), reduce growth rates and increase the risk of development of antimicrobial resistance.

The only milk which should be considered suitable for feeding to calves is saleable tank milk. Whole milk can be stored in a refrigerator for up to seven days at temperatures between 1 and 4°C.

While pasteurisation of whole milk reduces bacterial contamination, it is not guaranteed to eliminate all pathogens from the milk. Therefore the transmission of potentially milk-borne infections, e.g. Johne's disease, remains a risk. Pasteurised milk should be fed as soon as possible after pasteurisation and stored in scrupulously clean containers prior to feeding.

Calf milk replacers

Milk replacers have some benefits over raw milk, including a reduced risk of disease transfer (e.g. Johne's disease) and consistency of product when mixed correctly. However, milk replacers can have lower energy content than whole milk, be priced differently depending on differences in ingredients, manufacturing technologies and nutritional quality, and 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 as statutory requirements only include minimal information. The nutritional constituents required to be listed are crude protein, crude fat, crude fibre, and ash. Moisture content may also be listed.

Raw material ingredients must be listed in descending order of inclusion. Generally, higher-quality ingredients are more expensive.

While standard milk replacers typically contain 20–26% crude protein and 16–20% fat, the quality of raw materials used in the product will have a major bearing on calf performance.

Protein

Protein is necessary for tissue growth. Protein sources in milk replacers 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).

Skimmed milk is typically around 80% casein and 20% whey. The casein forms a clot in the abomasum and is digested like whole milk. The level of skim milk powder as a percentage of the total protein will determine how well a clot forms. Poor clot formation can increase the risk of diarrhoea, so a high percentage is desirable. It is also important to mix to the correct concentration 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 to skim-milk-based products and responsible for scours in young calves. Research does not support this – the highest quality whey protein products (e.g. whey protein concentrate) perform equally as well as skim milk powder.

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

Oil and fat

The oil content of a milk replacer is the key driver of total energy content. Calf milk replacers with higher oil content will have a higher energy content. Total energy supply to the calf is vital for the maintenance of bodily functions, including immune system development, and is the key driver of growth.

In the UK, calf milk replacers use vegetable fats (e.g. palm, coconut or soybean oil), which have similar digestibility to milk fat in calves over 3 weeks old.

Fibre

The fibre content of calf milk replacers can be used as an indicator of protein quality. The ingredient list should be viewed to determine the protein sources. Fibre levels over 0.20% indicate the inclusion of high levels of plant proteins.

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.

How much milk to feed

The exact amount to feed depends on:

- Calf liveweight
- Target growth rate
- Environmental conditions
- The nutritional composition of the product being fed

It is essential that an adequate quantity of milk is fed to support maintenance, development of the immune system and growth from the first week of life (see Figure 8).

To determine whether a growing calf is receiving enough energy from a milk replacer or whole milk to meet its growth rate targets, the calf's energy requirements should be calculated and compared to the total energy supplied.

The ME requirements of calves that are fed milk or milk replacer can be calculated from their body weight, target growth rate and environmental conditions. Environmental temperature, at calf level, has a significant bearing on energy requirements, particularly for calves less than 3 weeks of age. 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 L of whole milk per day.

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.

Calculating the energy supply from calf milk replacer

The Calf Milk Replacer Energy Calculator allows farmers to estimate the energy supplied by their calf milk replacer by entering information available on the label along with their feeding rates. Download the tool from **ahdb.org.uk/calf-milk-replacer-energy-calculator**

Research shows that feeding higher planes of nutrition pre-weaning benefits growth rates, health, and lifetime milk performance. Current advice for an average Holstein calf is to feed a minimum of 900 g/day which can be achieved by feeding different concentrations of milk replacer, as shown in the table below. Increasing the feeding rate increases growth rates, although the amount of calf starter being eaten at the same time must also be considered.

Table 2. Daily quantity of milk replacer per calf

Mixing rate (g/l)	Litres fed/day				
	4	5	6	7	8
150	600	750	900	1,050	1,200
140	560	700	840	980	1,120
130	520	650	780	910	1,040
125	500	625	750	875	1,000

= optimum = acceptable

Top tips for milk feeding

- Feed milk replacer at the concentration and volume required to achieve targeted growth rates
- Always read the label and mix milk replacer to the manufacturer's directions, unless under direction from a vet or qualified feed advisor
- It is recommended to feed at least 6 L per day, up to 150 g/L, during normal conditions
- Calves have a higher energy requirement in cold environmental temperatures – consider adapting feeding regimes to meet this need
- 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
- Drinking from a teat, rather than a bucket or trough, helps the calf satisfy its urge to suckle

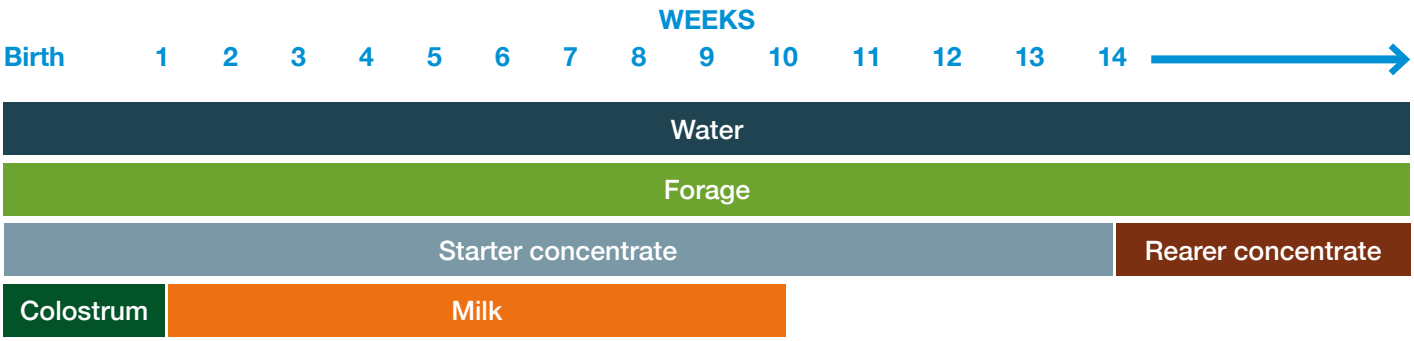


Figure 8. Example calf feeding timeline. Remember, volume of milk fed will increase with age as energy requirements increase

Figure 9. Drinking from a teat, rather than a bucket or trough, helps the calf satisfy its urge to suckle

Mixing milk

It is important to follow the manufacturer's instructions and ensure that everyone prepares the feed in the same way. Calves should be fed at the same time each day, at the same temperature and at the same concentration. The same product should be used consistently to avoid digestive upsets and negative impacts on performance. Mixing calf milk replacers at differing mix rates to those recommended by the manufacturer can have an adverse effect on calf health and performance. Cleanliness is paramount; equipment should be cleaned between feeds, using a detergent for feeders or buckets.

When mixing milk, milk powder should be made up with warm water at 45°C and fed at 37–39°C.

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

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.

To reduce biofilm formation, follow the six-step milk-feeding equipment washing protocol (Figure 10).

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

Watch our calf management and hygiene videos on the AHDB Dairy YouTube channel **youtube.com/AHDBDairy**

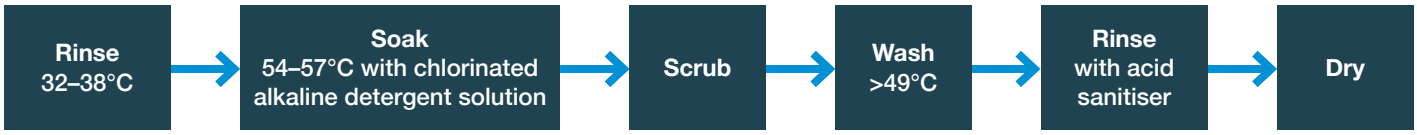


Figure 10. Six-step milk-feeding equipment washing protocol

Managing the transition to solid feed

Rumen development

At birth, the rumen is small, undeveloped and does not contribute to digestion. The newborn calf is a single-stomached (monogastric) animal, which only uses its abomasum for digestion in the first few weeks of life, which allows it to make use of highly digestible feeds such as milk.

The rumen must develop before the calf has the ability to degrade and subsequently digest forages. Development of the rumen involves the growth and multiplication of the rumen microbial population, production of volatile fatty acids, development of the rumen papillae and the beginning of muscular rumen contractions. The core rumen microbial population, along with biphasic ruminal movements, can be established by week 8.

Consumption of concentrates and water provides the rumen microbes with the nutrients they need to grow and multiply and to start to produce volatile fatty acids. Volatile fatty acids are the primary stimulator of rumen papillae growth, which are needed to absorb nutrients efficiently. Forage is essential for rumen expansion and prevention of the build-up of protein debris on the rumen papillae.

Starter concentrate

Starter concentrate feeds should be designed to promote rumen development, transitioning the calf from a milk-based diet to one based solely on forages and concentrates post-weaning. Providing a quality calf starter from day one is essential to stimulate rumen microbial population growth and rumen papillae development, which is vital for successful weaning.

In the first few weeks of life, calves only eat small amounts of concentrate feed, but intake should increase steadily with age. The earlier calves start to take concentrate, the more robust they will be at weaning, so offer small amounts of a palatable concentrate daily, disposing of stale feed.

Key steps to maximise starter intake:

- Starter can be provided as a pellet or coarse feed but ensure that sorting does not occur
- Starter should be highly palatable to encourage early intake
- Avoid powdery or dusty feeds, as this will reduce intake
- To avoid spoilage and wastage, provide small amounts of fresh starter daily
- Observe calves to see when they require more starter and ensure it is always available
- Provision of fresh water and forage are essential to maximise starter intake

A good starter should contain 18% crude protein fresh weight and a minimum of 12 MJ of energy (ME) in each kg of DM. To achieve maximum intake, it should be fresh, free from dust and mould and offered in clean buckets or troughs.

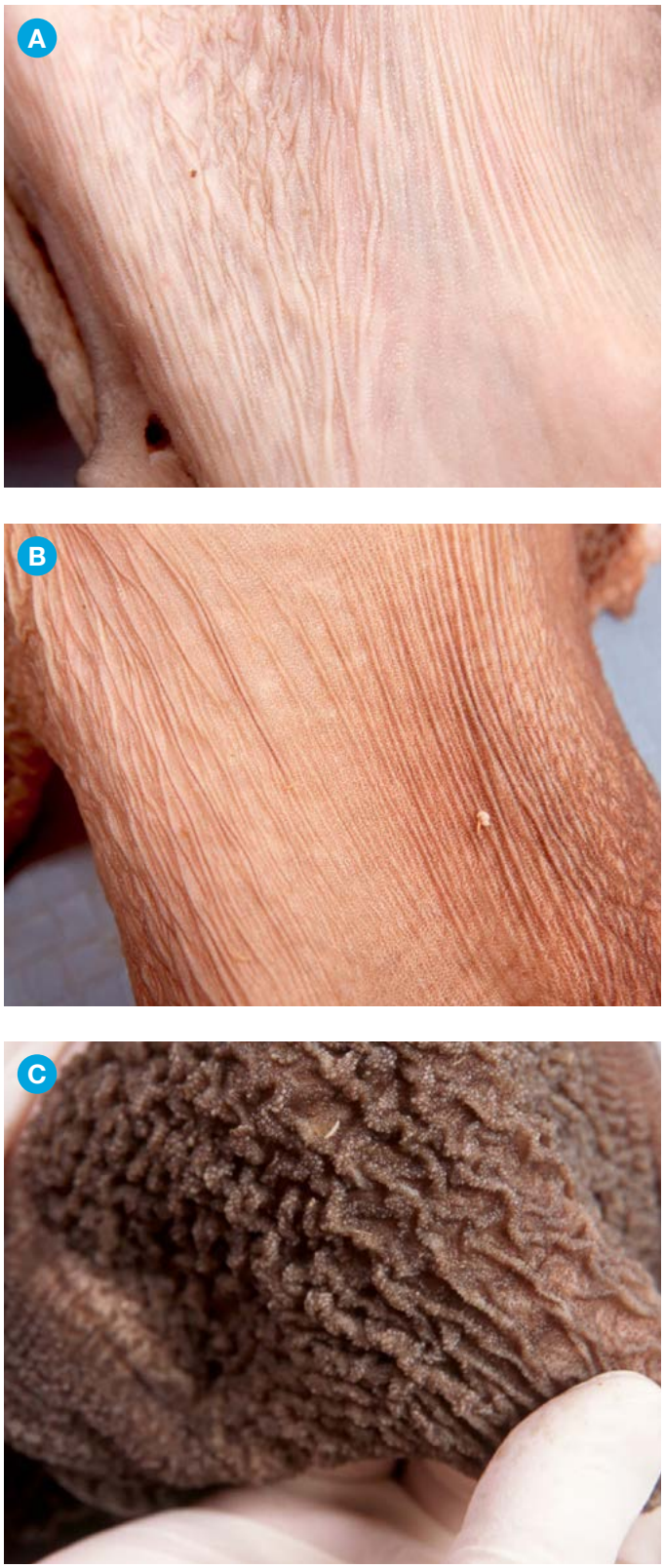


Figure 11. Rumen development of calves aged 6 weeks
A) Milk only, B) Milk and hay, C) Milk and grain-based starter
Source: Pennsylvania State University

Forage feed

Forages are the primary 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 from day one 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. Fresh straw should be offered in racks or troughs, separate from bedding material which is likely to become contaminated.

It is important to limit intake of very palatable, good-quality hay or other forages before weaning, as this can reduce starter intake and lead to calves becoming pot-bellied.

Water – an essential nutrient

Calves must always have access to fresh, clean water, in addition to milk or milk replacer. Water accounts for 70–75% of a calf's body weight and is fundamentally important for rumen development and the optimal growth of young calves. Water is required to support the microbial population of the rumen and promote rumen development and function. Research shows that drinking water increases starter intake.

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

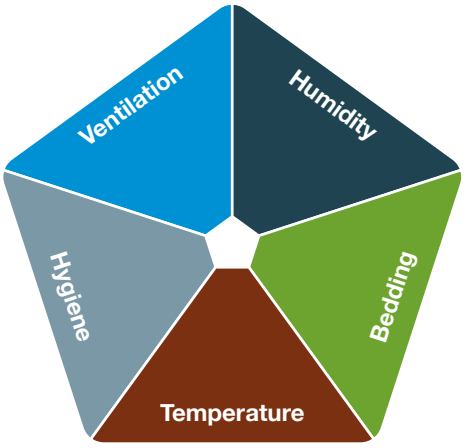
The location of the water supply must be considered to avoid contamination from faeces and spillage that would wet the bedding material. Remove any feed or bedding from water sources daily and keep water buckets outside of pens to reduce spillage of water onto bedding.

Why is providing water important?

- Providing water in addition to milk replacer can increase growth by 38% and starter intake by 31%
- Calves will drink, on average, 0.75 L of water per day during the first month of life
- Providing warm water (16–18˚C) during cold weather may increase starter intake

Figure 12. Offering calf starter from day one encourages rumen development

Five crucial factors affect the environment around the calf



Ventilation

A constant supply of fresh air is essential in calf housing to prevent respiratory and other diseases. While fresh air is essential, draughts at calf level should be avoided.

Good ventilation removes stale, humid air. Stagnant air contaminated with dust, moisture, ammonia and viruses, which can cause pneumonia, must be removed and replaced by fresh air. Cobwebs in buildings and condensation on the underside of roofing are signs of poor ventilation.

The use of large-volume or general-purpose buildings for calves is not recommended. The main reason is that young calves will not generate enough heat energy to drive the stack effect, which drives hot air up to the roof, where it cools and falls down the sides of the building. Big buildings will only provide ambient temperature, and youngstock risk suffering from cold stress.

There are situations where mechanical ventilation is valuable, and the vast majority of pre-weaned calf housing will benefit from mechanical ventilation (e.g. on still days). Often the layout and development of farm buildings leave areas that cannot be naturally ventilated. These areas can be significantly improved by either blowing air into the space (positive pressure ventilation) or sucking air out (negative pressure ventilation). In either case, it is still essential to provide adequate inlet and outlet areas and ensure no draught is created at calf level.

Movement of air within a calf shed can be visualised using smoke pellets. This helps to highlight stale pockets of air and demonstrates the air outlets. Airspeed can be measured using an anemometer.

Humidity

High levels of humidity allow pathogens to persist in the environment and spread from calf to calf. Good ventilation and drainage are key to reducing pathogen build-up.

Bedded pens should be laid out to ensure that drainage from the feeding area is running away from the bedding. This may require a drainage channel underneath the feeding area with good falls to a drain, usually outside the building.

The preparation of milk feeds and cleaning of feeding equipment results in a large amount of moisture in the environment. Where possible, preparation and cleaning should occur away from where the calves are housed.

For more information on housing, see **ahdb.org.uk/knowledge-library/dairy-youngstock-housing** and **ahdb.org.uk/knowledge-library/improve-beef-housing-for-better-returns**

High humidity and poor airflow in a building can result in pathogen build-up and heat-stressed calves, even in cooler months.

Hygiene

Good levels of hygiene are crucial to the reduction of pathogens within the calf environment and the risk of disease. Operating an ‘all in – all out’ system with thorough cleaning and disinfection between occupants is essential in reducing the risk of disease spread. Calf pens should be cleaned out at least every 30 days, with fresh bedding applied on a daily basis.

See the milk feeding and colostrum hygiene chapters for more information on milk-feeding hygiene.

Bedding

Supply plenty of dry bedding material to allow the calf to nest. When nesting, the calf’s back legs should not be visible. Dry bedding will keep calves 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.

Figure 13. Avoid locating water troughs/buckets over bedding

Temperature

The temperature the calf feels is a combination of temperature, airspeed and humidity. Monitor and record daily temperature in the calf shed using a min-max thermometer located at calf height. Even in cold weather, calves need plenty of fresh air, but avoid draughts at calf level. In the presence of draughts or damp, calves will use more energy to keep warm.

Lower critical temperature (LCT)

This is the temperature below which a calf needs extra energy to keep warm. Feed is directed away from growth and the immune system to maintain body temperature. Calves less than 3 weeks of age are the most vulnerable to changes in temperature and may be utilising energy to keep warm without any external signs of being cold.

- The LCT for calves less than 3 weeks of age is 10–15°C and is highly dependent on airspeed
- The LCT for calves over 3 weeks of age is 5–10°C and is highly dependent on airspeed

Upper critical temperature (UCT) and heat stress

In adult cattle, the Temperature and Humidity Index is used to combine the relative humidity and temperature to estimate when the upper temperature is likely to adversely affect welfare and reduce biological functioning.

This is less well understood for calves, but temperatures of around 25°C at typical UK humidities are considered to put calves under stress. More mature animals, which generate more heat from rumen fermentation, are at greater risk. Direct sunlight can also put calves under heat stress, even when the air temperature is modest, so access to shade is essential on sunny days.

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.

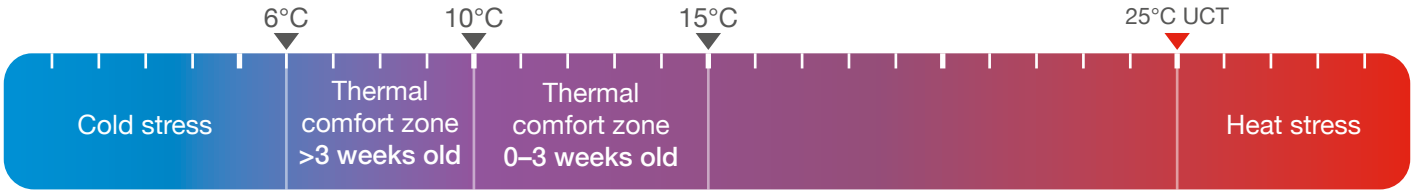


Figure 14. Thermal comfort zone of calves

Note. UCT = upper critical temperature

Managing calves in cold weather

In cold weather, calves require more energy to keep warm. Management of their environment and nutrition is essential in order to avoid negative impacts on health and performance. Calves must be fed enough milk and concentrate to provide them with extra energy to maintain their body temperature, grow and remain healthy.

Environment

- Ensure a draught-free environment at calf level
- Provide sufficient bedding to enable the calf to nest
- Create micro-environments for calves to nest in, e.g. behind straw bales, under lower ceiling areas
- Provision of external heat sources, e.g. patio heaters, has been shown to be effective in increasing growth rates, but the fire risk must be mitigated against
- Consider the use of calf jackets in younger or unwell animals

Nutrition

- Milk replacers with a higher fat content have a higher energy content and are therefore better able to support energy requirements in cold weather
- Consider feeding milk to calves three times a day
- The interval between milk feeds should not exceed 12 hours
- For calves less than 3 weeks old, feed an extra 50 g of milk replacer or 0.33 L of whole milk per day for each 5°C drop below 15°C
- For calves older than 3 weeks of age, feed an extra 50 g of milk replacer or 0.33 L of whole milk per day for each 5°C drop below 10°C, and ensure calves have continual access to starter
- Provide fresh water at all times

Figure 15. It is important to make sure the calf has sufficient energy to maintain its growth rate

Table 3. Recommended increases in milk/milk replacer provision at differing temperatures

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 to weaning
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 L (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 L with water.

+Based on a basic diet of 6 L of whole milk containing 4.03% fat and 3.28% protein, 22.3 MJ/kg ME on a dry matter basis.

Calf jackets

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

Considerations when buying calf jackets

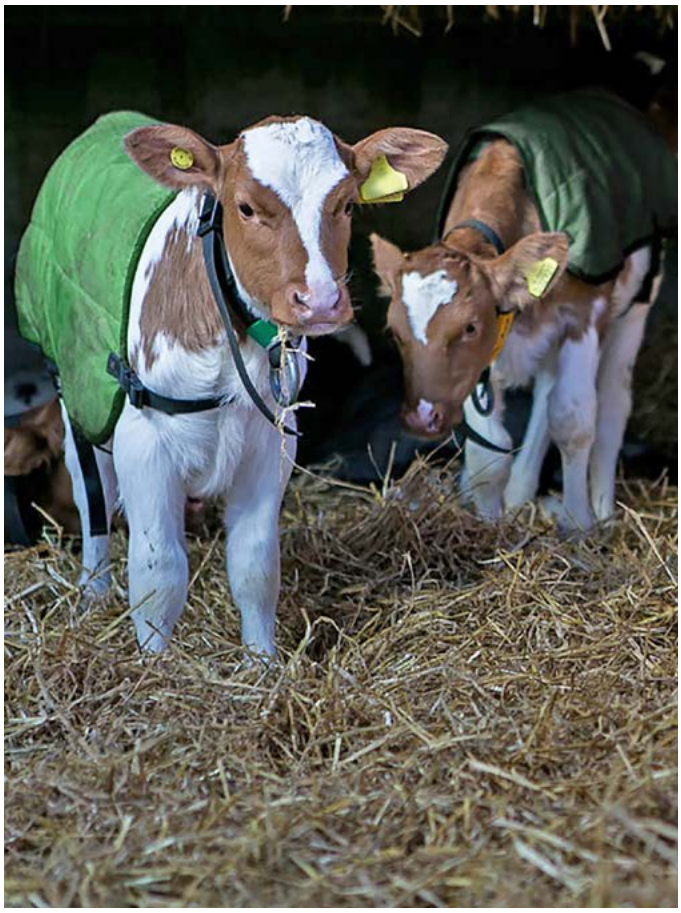
- Breathable material that allows moisture on the calf's coat to pass through
- Water-resistant or waterproof
- Machine-washable – jackets must be washed after each use to reduce the risk of disease transmission
- Straps and fasteners – different types of adjustable straps and fasteners are available.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

Tips for using calf jackets

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

Managing calves in warm/hot weather

At temperatures above 25°C, calves can become heat stressed. To counter this, they start to sweat, drink less milk and more water, eat less and spend longer standing to lose some of the excess heat. To aid cooling, energy is diverted to maintain core body temperature,



making less energy available for growth. Also, the immune system is suppressed, which reduces the calf's ability to fight disease.

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.

Maintaining growth rates during warm weather

- Ensure a constant supply of clean, fresh water
- Feed extra energy by increasing the volume of milk or milk replacer fed
- Replace starter daily to keep it fresh
- Keep water out of direct sunlight and change frequently if supplied in buckets
- 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
- Clean and disinfect water and milk-feeding equipment after every feed. Warm weather promotes the growth of algae, mould and bacteria

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.

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

When to wean

Healthy calves should be weaned based on concentrate intake and not on weight, size or age. From a nutritional perspective, the most suitable time to wean a calf is when it is consuming enough concentrate because this is the key indicator of rumen development.

Research suggests that it is beneficial to wean calves which have been on higher planes of milk nutrition (≥1,000 g calf milk replacer per day) at an older age (>12 weeks). The average weaning age in GB is 8 weeks. A minimum weaning age of 8 weeks is recommended because the ruminant digestive system will not be mature enough to sustain weight gain before this age. Feeding milk for longer has been shown to be beneficial for calf health and welfare. Only wean healthy calves that are growing well, and delay weaning for ill calves or for those with poor intakes.

Weaning should be based on concentrate intake rather than age.

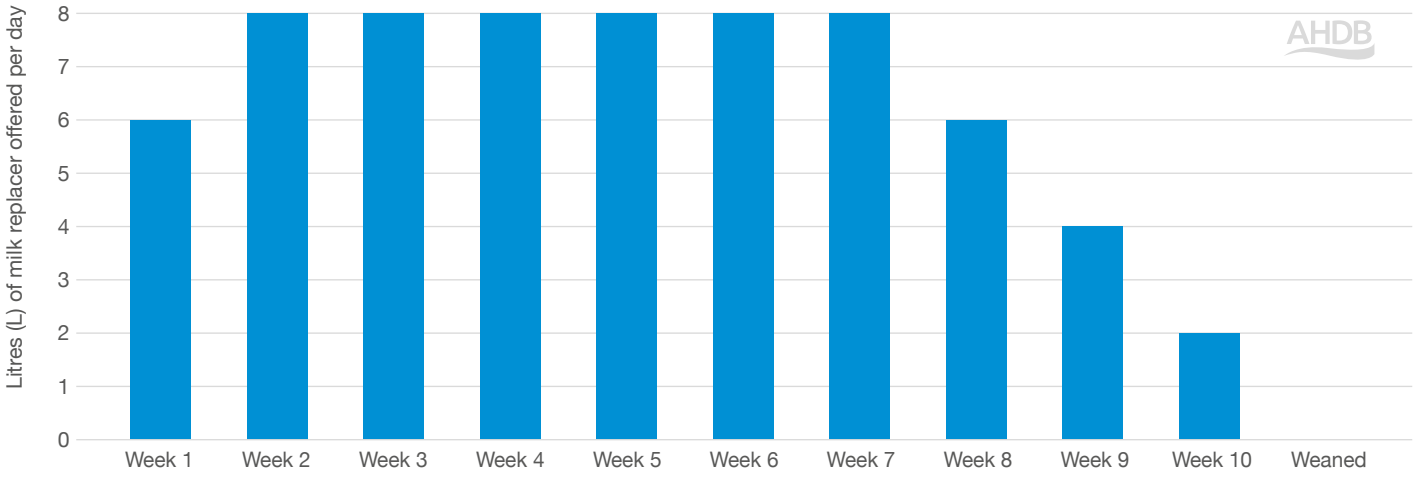
The recommendation is to only wean calves once they are consuming a minimum of 1.5 kg concentrate per day for three consecutive days.

How to wean

Weaning should be done gradually by reducing milk over a period of a minimum of 14 days, preferably longer. This will lead to increased concentrate intake, avoid a growth check after weaning and minimise weaning stress. It is advised that calves which have been on higher planes of milk nutrition (≥1,000 g CMR/day) are weaned over a longer period of time (e.g. 21 days).

Reducing milk can be achieved by:

- Reducing the volume of milk fed per feed
- Reducing the number of feeds per day



Source: AHDB

Figure 16. An example milk feeding programme

Note: this programme is based on calf milk replacer fed at a mixing rate of 150 g/ L and calves consuming a minimum of 1.5 kg concentrate per day for three days before weaning is completed.

Reducing stress at weaning

Stress at weaning can compromise calves' immune systems for at least two weeks after weaning. This can make calves more susceptible to disease, particularly pneumonia, and can compromise growth. Avoid changes to housing, feed, water or social groups for the two weeks after weaning. Also, avoid stressful procedures around the time of weaning, such as vaccination, disbudding and castration. Where the type of concentrate feed or forage is to be changed post-weaning, it is recommended that the change doesn't take place for at least two weeks after the withdrawal of milk and that the change is gradual, e.g. feed a mixture of concentrate feeds for two weeks before switching fully to the post-weaning product.

Disbudding and castration

Disbudding should take place as soon as the horn buds can easily be identified, and definitely within the first two months of life. At this stage, the horn buds are not yet attached to the skull, so the procedure involves less tissue trauma and is less stressful. Disbudding at younger ages has been shown to be less stressful for the calf and creates a small wound, which will heal more rapidly.

The most common way of disbudding calves is using thermal cauterisation, i.e. a heated disbudding iron, performed under local anaesthetic at the site of disbudding. Further information on disbudding is available online at **ahdb.org.uk/knowledge-library/how-to-disbud-dairy-calves-efficiently-easily-and-painlessly**

There are three main methods of castration. These are the application of a rubber ring, bloodless castration using the Burdizzo method and surgical castration carried out by a vet. Animals requiring castration over 2 months of age must be castrated by a vet. Appropriate anaesthetic and analgesic protocols should be used depending on the method of castration and the age of the calf. To minimise the negative impact of castration on performance, it is important the procedure is carried out as early as possible.

Group changes

In some systems, it is necessary for calves to change groups or move to a different unit after weaning, e.g. movement to a growing unit for beef calves or movement into a larger group of weaned calves on a dairy unit. This represents a potential point of stress for the calf.

Where a change of unit takes place, calves should be housed in a suitable shed on arrival that is clean, freshly bedded and well-ventilated. Arriving cattle should not be mixed with other stock. Avoid placing them in the same air space as animals that are already on the farm. When mixing calves from different sources, it is important to know the disease status of all source farms. Where appropriate, vaccination strategies should be discussed with your practising vet. Transport is recognised as a risk factor for diseases such as pneumonia. Only transport healthy calves and use licensed hauliers to minimise stress.

Any change in ration should be made gradually over a period of two to three weeks. If possible, feed the calves the same ration they were on prior to the move, then gradually introduce them to their new diet. The rumen takes time to adjust to fermenting new feeds, so abrupt changes can cause a growth check.

Monitoring growth

Measuring the growth rate of youngstock provides useful information about the effectiveness of current nutritional and management protocols and allows for early intervention if target growth rates are not being met. Visual assessment of body weight of calves is unreliable.

Work out a monitoring programme that fits with the system. Weighing can be timed to coincide with other routine procedures to monitor progress.

Benefits of monitoring growth

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

Key points for monitoring growth

- Birth
- Weaning
- One week post-weaning
- 6 months of age
- 12 months of age

Monitoring growth by weight or height

For dairy heifers both weight and height can be used to monitor growth performance. For beef calves, weight monitoring is recommended. It is important that you take regular measurements from your own animals using the same method each time. This allows you to benchmark your herd performance between groups.

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. Ensure that the weigh band you use is appropriate for the breed and age of cattle.

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.

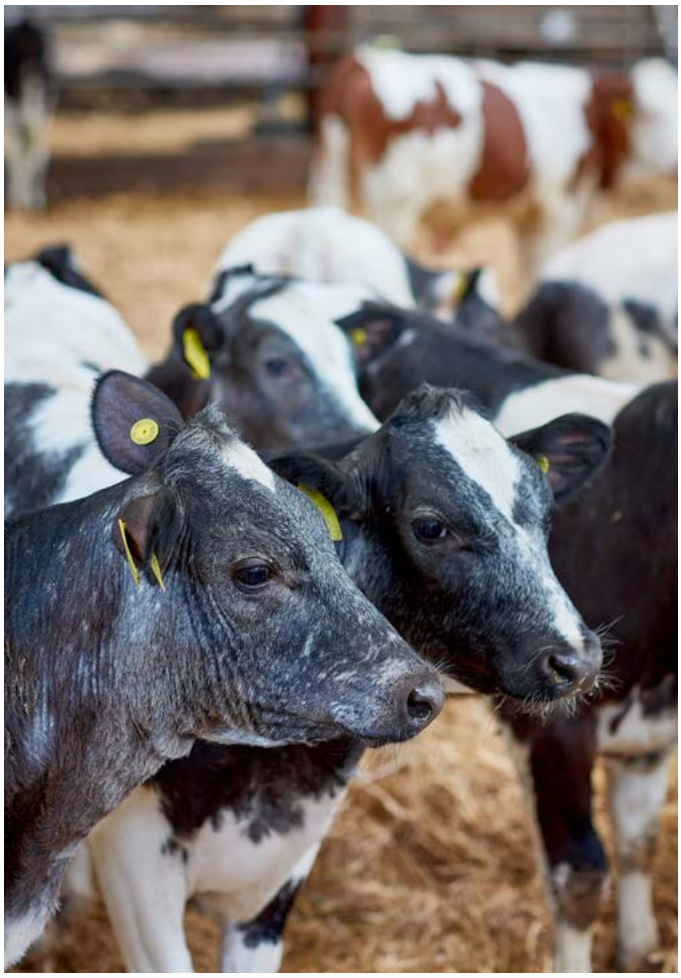
Figure 17. The most accurate way to weigh calves is to use a set of electronic weigh bars

Calculating growth rate

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).

Overall growth targets can be adjusted according to breed type and management system.

$$\text{DLWG (kg/day)} = \frac{\text{Current weight – start weight}}{\text{Age (days)}}$$



Targets for dairy heifer rearing

The key to successfully rearing heifers for a 24-month calving is to maximise growth without creating overfat heifers. It is important to base your targets on a percentage of the mature size of several third and fourth-lactation cows, 100–120 days in milk within the herd. For example, the target body weight of a dairy heifer just after first calving is a minimum of 85% of mature cow body weight.

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

Table 4. Target weight gains for dairy heifers depending on age

Age (months)	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	Service	377	55	87
24	After calving	582	85	96
Mature weight	Adulthood	685	100	

Note: calculations assume a minimum average growth rate of 0.8 kg/day and target mature weight of 685 kg.

Promoting calf health

As well as monitoring growth, it is important to monitor the incidence of disease problems on the farm. Keep a record of calves showing signs of ill health, cases of disease and losses. Speak to your vet to review performance, disease incidence and mortality, to set targets and to get advice on preventative strategies when disease incidence is higher than target.

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 and is more likely to survive, be productive and be profitable.

A healthy calf uses its feed more efficiently. Calves use their feed to maintain their normal body functions, then to keep themselves warm and fight disease, and finally, energy left over can be used for growth. 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 (see Figure 18 and 19).

Identify common problems

Health has a critical impact on the success of any calf-rearing enterprise. Veterinary advice should be sought on both preventative strategies and treatment protocols for disease. Performance should then be reviewed on a regular basis, and protocols adapted accordingly.

UK farms experience a high incidence of scours and respiratory disease before weaning. As such, it can be easy to accept the early signs of disease as 'normal'. It can also be easy to miss calves with mild diseases 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 potential.

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 pathogens in the environment
- Reduce the spread of disease

Useful resources

- Calf rearing notebook
- Calf health scorecard

Available online and in hard copy, visit **ahdb.org.uk**

Promoting calf health

1. Check calves at least twice a day – are your calves healthy?
2. Identify common problems early.
3. Record and monitor early signs of disease – discharge from eyes or nose, cough, dirty hindquarters and scour.
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 often a late sign of disease.

Figure 18. Energy expenditure by a healthy, warm calf – ideal

Figure 19. Energy expenditure by a sick, cold calf – inefficient

Pneumonia

Pneumonia is estimated to cost the UK cattle industry more than £60m/year. These costs are associated with decreased productivity, higher levels of mortality and increased veterinary and labour costs. The important viral causes of respiratory disease are Infectious Bovine Rhinotracheitis (IBR), Bovine Respiratory Syncytial Virus (BRSV) and Parainfluenza-3 virus (PI3). There are a number of bacteria associated with pneumonia, including *Mannheimia haemolytica*, *Pasteurella multocida*, *Histophilus somni* and *Mycoplasma bovis*.

BVD may also be associated with pneumonia in some herds due to the negative effects it has on an animal's immune status. These viruses can cause disease by themselves or damage the defence mechanisms of the upper respiratory tract, predisposing the lungs to secondary bacterial infections.

The vast majority of farms have a number of different respiratory pathogens present at any given time. Which of these pathogens are present and predominate often changes over time, particularly where units purchase stock in. Identification of the particular pathogens present may be useful in determining appropriate preventative strategies and future treatment protocols.

Respiratory disease may be seen as a result of pathogen challenge levels and the immunity of the calf. Where disease levels are high, this suggests:

- A large pathogen load (e.g. in a building with poor ventilation where exhaled pathogens can build up)
- A novel pathogen has been introduced that cows and calves have no previous exposure or immunity to
- Poor immune function, either due to poor colostral antibody intake, stress, poor nutrition or the presence of other immunosuppressive diseases such as BVD virus

Treatment

When faced with an outbreak of calf pneumonia, the first priority is the treatment of the affected animals and to minimise the spread of disease within the group.

Treatment will be most effective if it is given as early as possible. It is important that animals with pneumonia are rapidly identified and treated correctly; calves are very good at hiding disease initially, and many animals that appear clinically well may have an early disease. Taking temperatures of close-contact cohorts of sick calves may highlight some of these early cases. Look out for dullness, a loss of appetite, coughing, nasal or eye discharge and laboured breathing. Take the temperature of suspected cases to help identify animals with disease. A temperature above 39.4°C indicates an infection is present. A non-steroidal anti-inflammatory drug (NSAID) can reduce lung damage and aid recovery. Antibiotics are often also required but must be discussed with your vet.

Prevention

Preventing pneumonia in calves is always a better option than having to treat an outbreak. Pneumonia can cause irreversible lung damage, meaning that even if an animal recovers, its lifetime performance will suffer, and it will be more susceptible to future disease challenges.

Preventative strategies for pneumonia should take a rounded approach with the aim of both improving the calf's immune function and reducing pathogen challenge.

Factors that impact the calf's immune function

- Good levels of passive transfer of immunity from colostrum are essential in providing initial immunity to the calf
- Nutritional status has a major impact on the development of the calf's immune system. Animals fed low levels of milk are less robust than those on higher planes of nutrition
- Other concurrent diseases will reduce a calf's ability to fight off respiratory infection, such as BVD virus
- Stress – for example, due to handling, disbudding, castration, weaning or group changes – can reduce the effectiveness of the immune response
- Vaccination status. Vaccination programmes need to be tailored to the circumstances on individual farms. Care must be taken to ensure vaccines are handled and administered in accordance with the manufacturer's recommendations to ensure their effectiveness

Factors that impact the level of pathogen challenge

- Stocking density – high stocking density (proximity to other calves) increases pathogen challenge
- The total number of animals in a shared air space
- Mixing of cattle of different ages or from different sources increases the risk of pathogen challenge
- Ventilation – air circulation at calf level is important in removing both pathogens and respiratory irritants, e.g. ammonia, and ensuring delivery of fresh, clean air to the calf
- Humidity – increased humidity in the environment increases pathogen survival and impacts respiratory function. Check for leakages from water troughs, clean equipment outside rather than in the calf shed and ensure adequate ventilation. An outdoor milk feeding area can help reduce shed moisture levels (and keep bedding drier)

Mycoplasma

Mycoplasma is a bacterium which can cause pneumonia as well as ear, eye and joint infections. It can be introduced to a herd from purchased cattle and can spread rapidly between calves using shared feeding equipment and through respiratory secretions.

Rapid identification and early treatment are crucial to reducing the spread and minimising long-term damage.

Signs of mycoplasma

- Depression, reduced movement and feed intake
- Fever
- Cough and other signs of pneumonia
- Arthritis, seen as lameness and swollen joints
- Ear infection
- Droopy ears – one or both
- Discharge from the ear
- Head tilts and loss of balance

Treatment and prevention

Mycoplasma organisms are sensitive to certain antibiotics where treatment of calves is necessary, although once again, prevention is better than cure. Discuss treatment protocols with your vet. A non-steroidal anti-inflammatory drug can reduce lung damage and improve calf demeanour, thereby improving feed and milk intake.

Preventative strategies are similar to pneumonia, but as oral infection from teats, drinkers, and feeding equipment are more significant, additional consideration should go to the cleaning and disinfection of these items and prevent sharing them between different groups.

More guidance is available online at **ahdb.org.uk/mycoplasma-bovis**

Joint-ill or navel-ill

Navel-ill usually affects young calves and is an infection of the umbilicus that may then spread to other internal organs. Joint ill also involves infection of the calf, with entry to the blood from the nasal passages, tonsils, gut or navel, with subsequent infection of the joints. Signs of the disease depend on where the bacteria has spread to.

Signs of joint-ill or navel-ill

- Swelling around the navel
- Abscesses (of the naval or internally)
- High temperature
- Decreased appetite
- Swollen, hot joints

Treatment and prevention

Treatment as early as possible will prevent the spread of infection. Antibiotics and non-steroidal anti-inflammatory drugs (NSAID) are typically recommended by vets and may include extended courses. Discuss treatment protocols with your vet.

Infection is preventable through excellent hygiene around calving and prompt colostrum administration. Cows should be in a clean, well-bedded pen that is regularly cleaned out and disinfected. The calf's navel should be treated with strong iodine as soon as possible after birth and again 4–6 hours later.

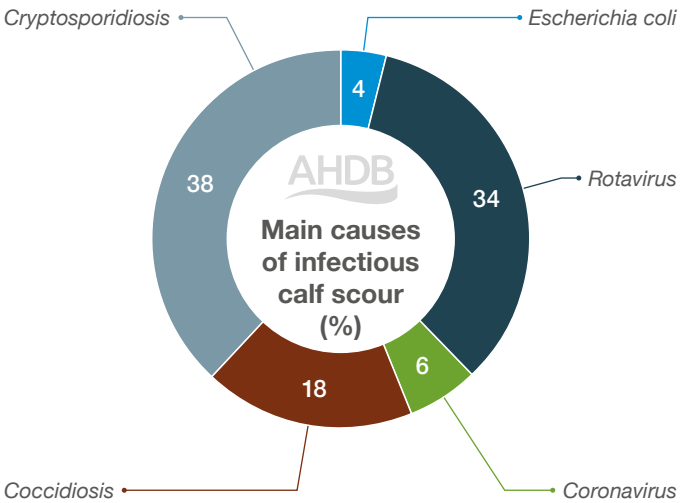
As with other diseases, it is essential calves receive enough colostrum to reduce infection risk. See the colostrum chapters for more information.

Scour/diarrhoea

Calf scour (diarrhoea) is the most common disease in young calves, accounting for about 50% of all calf deaths. The disease can be easily recognised, and it is important that treatment is administered rapidly to maximise the chance of survival.

Diarrhoea can be caused by a variety of non-infectious and infectious causes and can vary considerably in clinical severity. There are a number of different infectious organisms that can cause scours, including *Cryptosporidiosis*, *Rotavirus*, *Coccidiosis*, *Coronavirus*, *E. Coli* and *Salmonella*. Timing of the onset of disease may give some indication of the likely pathogen, but this cannot be relied upon. Consistency, colour and smell of the diarrhoea is an unreliable guide to the underlying causal organism.

The most common non-infectious cause of diarrhoea is nutritional scours, which can be caused by inconsistent feeding, lower-quality calf milk replacer products or inappropriate concentration. This can be minimised by ensuring milk is always prepared and fed in the same way and at an appropriate concentration using a high-quality product.



Source: AHDB

Figure 20. Main causes of infectious calf scour

Treatment

For all causes of scour, treatment is focused on rehydration and prevention of acidosis that occurs due to fluid loss from the calf's digestive tract. It is essential that treatment is started as soon as scour is observed. Delay will substantially increase the probability of treatment failure and result in reduced feed intake, feed conversion and growth.

Isolate infected animals to reduce the risk of spreading disease to other calves in the group. Scouring calves will consume greater volumes of water, so they must be provided with continual access to water.

Laboratory analysis of faeces will be able to determine the cause(s) of scour. This will ensure the correct treatment is given and enable measures to be put in place to minimise reoccurrence in the future.

- Rehydration of infected calves is key for survival. Feed 2 L 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.
- A licensed product to prevent cryptosporidiosis and reduce egg shedding and the severity of calf scour may be prescribed by your vet and used under their direction. Ensure dehydrated calves are fully rehydrated before treatment.

Prevention

As most farms have the pathogens present within the herd, with the possible exception of salmonella, disease is largely a product of pathogen challenge and immunity. Prevention is about reducing the exposure level of the calf and maximising immune function.

- The first step in any preventative strategy for calf scour is to ensure adequate passive transfer of immunity from colostrum.
- Vaccination of the cow prior to calving can help reduce the prevalence of scours in calves by ensuring there are specific antibodies present in the colostrum. It is possible to vaccinate pregnant dams against Rotavirus, Coronavirus and E. coli, thereby reducing scours caused by these pathogens. Vaccination strategies are reliant upon the calf receiving an adequate colostral transfer of immunity.
- Hygiene is paramount in the prevention and control of calf scours. Environmental hygiene controls need to begin from the moment the calf is born to minimise the potential for pathogen transmission in the calving area. Calving pens should be fully cleaned out as a minimum every 21 days. Calf pens should be cleaned out at least every 30 days. Specific care should be taken to clean and disinfect feeding equipment between feeds.

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.

Large numbers of eggs are shed in the faeces of infected calves and cows, which contaminates the environment. Eggs can be found in bedding, pasture, soil and water. Infected calves shed up to 1m 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. 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 the manufacturer's instructions and left to dry completely.

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.

Cryptosporidium eggs are only destroyed at temperatures above 60°C.

Many common farm disinfectants are not effective against Cryptosporidium. Therefore, check that the product you are using is licensed as effective against Cryptosporidia and always follow the manufacturer's guidelines for use.

Coccidiosis

Coccidiosis is a disease caused by *Coccidia*, which are small parasites that damage the lining of the intestine. It is spread by calves eating, drinking or licking contaminated feed, water or objects. *Coccidia* can be found on most cattle farms and are able to survive in the environment from one year to the next.

Signs will depend on the severity of the infection. In the most severe form, calves will pass diarrhoea containing blood or mucus. These animals will show signs of dehydration and may be seen to strain to pass faeces. Less severely affected animals will show signs of ill thrift and may or may not have scour. These calves will have reduced feed intakes and poorer growth rates.

Diagnosis is based on the presence of clinical signs in a group of calves and through examination of faecal samples. Contact the vet if Coccidiosis is suspected, as they will be able to advise on the diagnosis and correct treatment.

Responsible medicine use

Striving for healthy, productive animals is every farmer's goal; healthy animals are less time-consuming to manage and are more productive than those affected by ill health. Farmers in the UK adhere to some of the highest welfare standards in the world, but without gathering information about medicine use, it is hard to prove this.

Recording antibiotic use is important in the battle against AMR (antimicrobial resistance), which arises when medicines become less effective at killing or stopping microorganisms from growing, making infections harder to treat.

Resistance occurs naturally but is made worse when antibiotics are overused. Using 'as little as possible but as much as necessary' has become a familiar phrase to many and is reflected in herd health plans up and down the country.

Medicine Hub, which is hosted by AHDB, is an industry-wide voluntary initiative set out to build the first national database of antibiotic use for the ruminant sector. Medicine Hub's creation has involved input from veterinary and farming organisations, milk processors, milk and meat buyers, retailers, the VMD and RUMA (Responsible Use of Medicines in Agriculture Alliance).

Sharing data with Medicine Hub will demonstrate the high standards UK farmers work towards for customers, processors and retailers and is increasingly becoming a topic for discussion in trade negotiations.

More information is available at **medicinehub.org.uk**, and support is available by phone (02477 719 414) or via email at **medicinehub@ahdb.org.uk**

Relevant resources

AHDB publications

Calf rearing notebook
Youngstock housing guide
Calf health scorecard
InCalf guide for GB farmers calving all-year-round
InCalf guide for GB farmers with block calving herds
Beef diseases directory
Improve beef housing for better returns

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