Calf management
Raising heifer calves is the second largest annual expense, approximately 20 per cent of a dairy business’s production costs, after feed. 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 that incorporates all the latest research and management advice. In return, they will repay the investment through higher milk production and a longer productive life.

Dairy farmers make decisions every day that can affect the health and welfare of their calves. Research at the Royal Veterinary College has shown that mortality rates of liveborn dairy heifers in their first month of life on GB farms ranged from 0–12 per cent. As there are farms achieving low mortality rates, it indicates losses can be avoided when good management practices are in place.

AHDB Dairy has produced this series of factsheets and associated short films to provide information on how to optimise calf performance. Areas that need consideration to rear healthy calves and, thereby, keep mortality to a minimum are:

- Making the most of colostrum
- Ensuring thermal comfort and sufficient feed intakes
- Monitoring growth rates (weight and height)

Key messages

- Newborn calves must receive at least three litres or 10 per cent bodyweight of colostrum within two hours of birth
- Test colostrum quality using a a Brix refractometer or colostrometer. Only feed colostrum with at least 50g/l of antibody (IgG)
- Teat feeding with a nipple bottle is best
- Use a stomach tube if a calf is unable to suckle a bottle or is too weak to consume the full amount of colostrum
- Improve 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 one week post-weaning, six months of age and at breeding
The three Qs of feeding colostrum: Quickly, Quantity and Quality

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

Quantity
The recommendation is to give a first feed of three litres in the first 6 hours, split into 2 feeds if necessary. This should be followed up by another similar size feed within 12 hours of birth.
The colostrum should be fed at body temperature of 38°C.

Quality
- It is essential that calves receive 3 litres, or 10 per cent of body weight, of good quality colostrum that has been tested
- Good quality colostrum contains at least 50g/l of IgG. Any colostrum containing <20g/l of IgG should not be used
- Colostrum quality declines the longer it is held in the udder as it becomes more dilute with time
- You cannot tell 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 to ensure best possible colostrum is collected and fed to newborn calves
- Quality will decline if the colostrum becomes contaminated with bacteria

Quickly
It is very important that calves receive their first colostrum feed as soon as possible after birth, ideally within two hours, to optimise immunity.

The efficiency of antibody absorption from colostrum declines rapidly from over 40 per cent at birth to less than 5 per cent by 20 hours.

Ensure you have a supply of good quality frozen colostrum, from cows of known health status to use if the dam’s own colostrum is not of sufficient quality.

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

Figure 2. Effect of time first colostrum fed against antibody absorption. After 10 hours the calf’s ability to absorb enough IgG is dramatically reduced

Figure 3. Colostrum quality declines after 6 hours
Method of feeding

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

- **Nipple bottle** – promotes transit of the colostrum to the true stomach
- **Tube feeding** – ensures that the full volume of colostrum is received by the calf but this is a skilled technique which 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 it receives the full three litres.

Monitoring

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

Blood testing your calves can tell you how good your colostrum management is. Ask your vet to take samples from at least twelve calves within one week of their birth. Samples can be tested for either the actual antibody (IgG) level or the total protein (TP) in the blood. At least 80 per cent of the group should be categorised as 'good'. Any less and you should examine the potential causes.

<table>
<thead>
<tr>
<th>Quality</th>
<th>IgG g/L</th>
<th>TP g/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>&gt;12</td>
<td>&lt;55</td>
</tr>
<tr>
<td>Marginal</td>
<td>10–12</td>
<td>50–55</td>
</tr>
<tr>
<td>Poor</td>
<td>&lt;10</td>
<td>&lt;50</td>
</tr>
</tbody>
</table>

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

Future care

Even good quality colostrum fed on time only contains a limited amount of antibodies. The newborn calf does not yet make more of its own antibodies. It is, therefore, vital to follow up 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 as soon as possible after birth to all calves.

Remember the three Qs:

- Quantity – three litres
- Quality – contains at least 50g/l of IgG
- Quickly – within two hours of birth

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

Contamination during collection, transfer or feeding puts the calf at risk by introducing harmful bacteria when the calf has no active immunity to fight infection.

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 Johne’s positive or suffering from postcalving conditions.

Ensure udder cleanliness. An effective teat disinfectant 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.

Sanitise the cluster and pipework, both inside and out after every use.

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

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

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

Table 2. Colostrum storage methods

<table>
<thead>
<tr>
<th>Refrigeration</th>
<th>Freezing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of storage</td>
<td>24 hours</td>
</tr>
<tr>
<td>Storage method</td>
<td>1–2 litre containers</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>4°C</td>
</tr>
</tbody>
</table>

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 regularly check the temperature of fridges and freezers with a thermometer.

Pasteurising colostrum
Pasteurisation is not a storage method but rather a way to reduce the number of bacteria present, therefore, the colostrum still needs to be chilled or frozen.

If using a pasteuriser, refer to the manufacturer’s instructions with regard to batch quantities.

Pasteurisation does not make low quality or highly contaminated colostrum fit to be fed.
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, maximum temperature of 50°C, so the colostrum itself reaches 40–42°C. This allows for a slight cooling before it reaches the calf.
Once warmed, use within 30 minutes.
Check the temperature using a thermometer.

Hygiene testing
If you are concerned about whether you are at risk of feeding contaminated colostrum to your calves, you can have it tested.
Testing colostrum for bacterial counts can help identify if changes are needed to the way colostrum is collected and stored.
The sample should be taken just before it is fed to the calf.
Ask your vet for more details.

Beware!
Do not use a microwave to reheat/thaw the colostrum nor overheat as this will destroy the antibodies.
Testing colostrum is an important task that should be completed 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 free from any visual dirt and contaminants such as manure; you should also check for any cracks or breaks in the glass
- Refractometers should be calibrated before each use

**You will need:**
- Clean refractometer 0–32% scale
- Distilled water
- Clean cloth
- Jug – sterilised
- Collostrum at room temperature

**Procedure**
- The refractometer should be calibrated before every use. Put 2–3 drops of distilled water on the glass surface
- Lower the cover over the sample so the water spreads across the entire surface without any air bubbles or dry spots
- Allow 15 seconds before taking a calibration reading – this allows the sample to adjust to room temperature
- Hold the refractometer up to natural light while looking down the eye piece – avoid fluorescent light sources
- As you look down the eye piece 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
- Wipe clean the surface with a clean soft cloth
- Once dry, place a couple of drops of colostrum onto the glass surface and repeat the process
- Take a quality reading, for the colostrum
- Once you are happy with the reading, ensure you clean the slide and glass ready for the next time

**Taking a reading**

High-quality colostrum which has a reading above 22% can be used or stored

22% = 50mg/ml immunoglobulin

Colostrum with a reading below 22% should be discarded.

Brix refractometer – 0–32% scale
Using a Colostrometer

Testing colostrum is an important task that should be completed 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
- Jug – sterilised
- Colostrum at room temperature
- Measuring cylinder – tall enough to allow the colostrometer to float

**Procedure**
- Use a clean dump bucket and transfer the colostrum to a clean bucket with a lid
- Take a sample of the colostrum, using a sterilised jug
- Pour the colostrum into the measuring cylinder
- The colostrum should be tested at a fixed temperature, ideally room temp of 22°C – not body temp or direct from the refrigerator
- There should be no froth on the colostrum
- The colostrometer should be floated in the colostrum – leave for one minute before taking a reading

*Figure 8. There is no way of assessing the quality of colostrum by eye. The density and colour is not an accurate indication.*
Taking a reading
Read the value where the colostrometer is floating at the surface of the colostrum.

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

Readings in the red zone indicate poor quality – less than 20mg/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 suckle a bottle, or consume the full amount of colostrum, then a stomach tube should be used. This is a skilled technique which requires training to ensure the correct placement of the tube.

See how to tube a calf using our Colostrum Feeding video on the AHDB Dairy YouTube channel [youtube.com/AHDBDairy](http://youtube.com/AHDBDairy)

Method of feeding

You will need:
- Feeding tube (plus spare)
- Colostrum warmed to 38°C, at least three litres
- Marking equipment, either pen or tape
- 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

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 upright
- Minimise stress to other animals in the pen, by working quietly and calmly
- 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 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

**Beware!**

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

Inserting the tube
- Before inserting the tube into the calf’s mouth, moisten the tube with either warm water or colostrum
- Raise the calf’s head and squeeze the sides of the mouth gently to open its mouth
- Slowly push 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
- Once in the correct place, the calf should appear comfortable and be swallowing
The windpipe is naturally 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.

**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 38ºC.
- Control the flow rate of the colostrum by raising and lowering the bag.
- Keeping the bag low will be more comfortable for the calf.

**Checking placement**
- Feed the colostrum at a slow rate to ensure the calf regurgitates less.

**Top Tips**
- Beware! Removing the tube prematurely, while there is still liquid in the bag/tube may cause colostrum to enter the lungs.
- Once the colostrum is finished, kink the tube and withdraw it in one swift movement.

**Removal of the tube**
- Control the flow rate of the colostrum by raising and lowering the bag.
- Keeping the bag low will be more comfortable for the calf.

**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.
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 per cent of body weight was translated into feeding two litres of milk twice daily. This does not provide sufficient energy to growing calves.

Feed 15 per cent of calf bodyweight in whole milk or suitable milk replacer.

Remember as calves grow in size, they will require more energy and, so volume and energy will need to 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 to feed calves under 28 days old at least two liquid milk feeds per day.

Do not feed waste milk (antibiotic treated milk, 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.

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 cows that are Johne’s positive.

Do not feed waste milk (antibiotic treated milk, 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.

<table>
<thead>
<tr>
<th>Water</th>
<th>Forage</th>
<th>Rearer concentrate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Starter concentrate</th>
<th>Colostrum</th>
<th>Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth 1 2 3 4 5 6 7 8 9 10 11 12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 11. Example rearing/feeding timeline
Achieving growth

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

Calculating the energy requirements of the growing calf will identify if the calf is receiving enough energy from milk replacer or whole milk to meet growth rate targets. The energy content of whole milk (3.28 per cent protein and 4 per cent fat) on a dry matter basis is 22.71MJ/kg. Using the information from the milk replacer label, the energy content provided by milk replacer can be estimated.

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

The total feed requirements of the calf depends on the 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 but first, lactose, one of the energy sources, needs to be estimated.

Lactose is not usually a given constituent on the label, but lactose content can be estimated as the dry matter which 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 will also have to be deducted
- If not stated, then assume 5 per cent moisture

\[
\text{ME (MJ/kg)} = (0.057 \times \% \text{ crude protein}) + (0.092 \times \% \text{ fat}) + (0.0395 \times \% \text{ lactose}) \times 3.77
\]

Using the example, calf milk replacer label:

\[
\text{ME (MJ/kg)} = (0.057 \times 26) + (0.092 \times 16) + (0.0395 \times 51) \times 3.77
\]

\[
= (1.482) + (1.472) + (2.0145) \times 3.77
\]

\[
= 4.9685 \times 3.77
\]

\[
= 18.73\text{MJ/kg on a dry matter basis}
\]

This formula estimates the energy provided by 1kg of milk replacer. Energy supply per calf can be estimated by multiplying energy density by kilograms of milk replacer fed per calf per day.

Using this example, if 750g of milk replacer is fed, the energy provided to the calf is: 18.73MJ/kg x 0.75 = 14.05MJ/d

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:

dairy.ahdb.org.uk/milkreplacercalculator

Figure 12. The most accurate way to weigh calves is to use a set of electronic weigh bars
Calculating the energy requirements for calves fed only milk or milk replacer

The energy requirements (ME) for calves fed milk or milk replacer at different liveweights with various daily gains is detailed in the table below. 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 (less than three weeks of age) extra energy by providing an extra 50g of milk replacer or 0.33l of whole milk per day.

The calculations behind the numbers in the table below are:

**ME maintenance** is the amount of energy a calf needs to maintain current body weight and is calculated as: 
\[4.2 \times (0.1 \times \text{liveweight}^{0.75})\] at 15°C to 20°C.

**Total ME for maintenance and growth** is calculated as 
\[0.1 \times \text{liveweight}^{0.75} + [(0.84 \times \text{liveweight}^{0.344}) \times (\text{daily liveweight gain}^{1.2})] \times 4.2\] at 15°C to 20°C.

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

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


*These energy requirements are calculated for environmental temperatures between 15°C and 20°C.
Calf milk replacers

Price differences in milk replacers can be due to differences in ingredients, manufacturing technology and nutritional quality. It is important that producers understand these differences and make informed decisions.

Advantages and disadvantage of using milk replacer

Advantages

- Reduces risk of disease transfer (eg Johnne’s disease and BVD)
- Consistency of product, when mixed correctly – less risk of digestive upsets and scour

Disadvantages

- Lower energy (due to fat content) compared to take over milk
- Products with plant-based proteins have a lower digestibility in calves under three weeks old

Understanding the label

It is difficult to assess milk replacer quality from the label. The only legal requirement is that ingredients are 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 per cent crude protein and 16–20 per cent fat to achieve optimal growth rate in early life.

Protein

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

Calves are better able to digest powders with milk-based proteins, particularly those less than three weeks of age.

Skim and whey milk proteins

Skim milk-based powders are, typically, around 80 per cent casein and 20 per cent whey, the casein forms a clot in the abomasum and is digested like whole milk. Whey-based powders are digested in the small intestine and do not form a clot in the abomasum due to the absence of casein.

Traditionally, it was thought that milk replacers that did not form a clot were inferior and responsible for scour in young calves. Recent research does not support this and suggests that 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 two weeks old.

Beware!

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

Figure 13. Consistent feeding temperature, total solids, and nutrient level helps calves perform at their best
Fibre
Fibre is an indicator of protein quality, and the ingredient list should be viewed to determine the protein sources.

- Products with less than 0.15 per cent fibre contain milk or egg
- Fibre levels over 0.20 per cent indicate 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 or not protein, fat, fibre and ash are 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 per cent moisture

Ash
Ash indicates the overall level of minerals.

- The ash content should not be higher than 8 per cent

Vitamin and mineral
Declared minerals generally 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
- Consistency is the key
- Always read the label and mix to the manufacturer’s directions
- Feeding six litres per day up to 150g/l during normal environmental conditions is recommended
- Only use 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
- Cold environmental temperatures will mean calves have a higher energy requirement.

Table 14. Example of information found on a milk replacer label

<table>
<thead>
<tr>
<th>Analysis (on dry matter)</th>
<th></th>
<th>Trace Elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crude protein</td>
<td>26%</td>
<td>Calcium</td>
</tr>
<tr>
<td>Crude oils and fats</td>
<td>16%</td>
<td>Sodium</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>0%</td>
<td>Phosphorous</td>
</tr>
<tr>
<td>Crude ash</td>
<td>7%</td>
<td></td>
</tr>
</tbody>
</table>

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, emulsifierlecithin

<table>
<thead>
<tr>
<th>Additives</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamins</td>
<td></td>
</tr>
<tr>
<td>Vitamin A</td>
<td>2500 IU</td>
</tr>
<tr>
<td>Vitamin D3</td>
<td>6000 IU</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>250 IU</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Antioxidents</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Net weight</td>
<td>Best before</td>
</tr>
</tbody>
</table>
Managing the transition to solid feed

At birth, the rumen is small, undeveloped and does not contribute to digestion. The rumen needs to develop before it can digest forages. The intake of concentrate and water 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 five days of age with the majority of calves actively ruminating by 28 days of age.

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

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

Starter concentrate

Calf starter should be offered from day one.

- 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
- 3cm pellets are the most common
- Should be larger than 1.19mm in diameter to avoid ruminal parakeratosis and bloat
- Should not be powdery or dusty as this will reduce intake

- Calf nuts of 6mm are designed for feeding to calves at 12 weeks or older
- Starter should provide around 18 per cent crude protein to aid microbial growth and promote intake

Calves eat only small amounts in the first few weeks but intake begins to increase measurably around 14 days of age.

Forage feed

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

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

Feed racks and buckets should be located at a height that is suitable for calves and positioned so as to reduce possibility of soiling.
Water – an essential nutrient

Water accounts for 70–75 per cent of a calf’s body weight and calves will perform best with fresh drinking water available to them from birth.

Why is water important for calves?
Water is fundamentally important to rumen development and optimal growth of young calves.

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

Beware!
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 per cent and starter intake by 31 per cent
- Calves will drink 1 litre of water per day during the first week of life, increasing to nearly three 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 intake of water will increase to maintain hydration and normal body function.

Water quality and cleanliness
Location of the water supply needs to be considered to avoid contamination from faeces and reduce wet bedding material due to spillage.

Clear out water sources daily of any feed or bedding.

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 continuous access to water.

Figure 14. 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 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.

Newborn to three weeks of age
- Calves less than three weeks of age are the most vulnerable to changes in temperature
- The lower critical temperature for calves less than three weeks of age is between 10–15°C and is highly dependent on air speed
- Feed an extra 50g of milk replacer or 0.33l of whole milk per day for each 5°C drop below 15°C

Feed more energy
Additional milk replacer or whole milk required, regardless of body weight, to achieve optimal growth with a growth rate target of 0.75kg/day.

Calves older than three weeks of age
- The lower critical temperature for calves over three weeks of age is between 6–10°C and is highly dependent on air speed
- Feed an extra 50g of milk replacer or 0.33l of whole milk per day for each 5°C drop below 10°C
- Calves should have continuous access to starter feed

Feed is directed away from growth and the immune system to keep warm.

<table>
<thead>
<tr>
<th>Environmental Temperature °C</th>
<th>g/d of additional milk replacer*</th>
<th>I/d of additional whole milk*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Birth to 3wk</td>
<td>3wk to weaning</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>0</td>
<td>150</td>
<td>100</td>
</tr>
<tr>
<td>-5</td>
<td>200</td>
<td>150</td>
</tr>
<tr>
<td>-10</td>
<td>250</td>
<td>200</td>
</tr>
</tbody>
</table>

*Based on a basic diet of 6 litres (900g) of milk replacer with 18% fat and 22% protein containing 18.5MJ/kg of ME mixed at a rate of 150g made up to 1 litre with water. +Based on a basic diet of 6 litres of whole milk containing 4.53% fat and 3.28% protein, 22.3MJ/kg of ME on a DM basis.
To maintain desired growth rates during periods of cold weather follow the guidance below.

**Housing**
- Monitor temperature daily in the calf shed
- 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

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

**Environment**
Even in cold weather, calf housing needs plenty of fresh air. Draughts must be avoided at calf level.
The temperature the calf feels is a combination of temperature, airspeed and humidity.

**Air speed at calf level**

<table>
<thead>
<tr>
<th>Air speed (m/s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.15</td>
<td>Stale air – increases bacteria survival and pneumonia</td>
</tr>
<tr>
<td>0.2</td>
<td>Draught-free</td>
</tr>
<tr>
<td>0.3</td>
<td>Draught on calf – calf will become chilled</td>
</tr>
</tbody>
</table>

Notes: m/s = metres per second

**Table 6. The temperature the calf feels is a combination of temperature, airspeed and humidity.**

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Airspeed (m/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newborn (35kg)</td>
<td>0.2/m (draught-free) 0.3/m</td>
</tr>
<tr>
<td>One month (50kg)</td>
<td>2.0/m</td>
</tr>
</tbody>
</table>

+9 +17 +9

Source: Webster, 1981

**Timing of feeds**
Consider feeding milk to calves three times a day. Interval between milk feeds should not exceed 12 hours.
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 spreading diseases between calves
- Straps and fasteners – different types of adjustable straps and fasteners are available. Velcro will clog and requires additional cleaning and maintenance. Simple, clunky plastic clips are preferable. Check with the supplier that replacements are available

Management tips

1. Monitor and record daily temperature in the calf shed using a min-max thermometer.
2. Agree a protocol with the farm team to include temperature at which calves will start to experience cold stress.
3. Calves less than three weeks are most vulnerable to extreme temperatures, therefore prioritise these if the temperature is below 15°C.
4. Calves older than three weeks may not need a jacket unless the temperature is below 5°C.
5. Put jackets only on dry calves. Wet calves must first be dried thoroughly until they have a dry, fluffy coat.
6. Use only 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 snuggly 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 soiled or wet jackets with a clean, dry one.
11. Removal of jackets will entirely depend on 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 completely dry between each use.

For further details specifically on cryptosporidium, see the section on page 27.
**Bedding tips**
- When nesting, the calf’s legs should not be visible
- Dry bedding will keep jackets relatively clean and dry
- While sand, sawdust or shavings are suitable bedding choices for summer months, these options are poorer choices for winter since they provide no thermal protection to the calf
- Straw is the ideal bedding for winter

**Monitoring calves**
- Monitor growth using a weigh scale, weigh band (pictured below) 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
Managing calves in warm/hot weather

In warm or bright conditions, when there is heat and light intensity, calves are at risk of heat stress. During these periods, energy is used to lose heat from the body by sweating and increasing respiratory rate.

**Upper critical temperature (UCT)**
At environmental temperatures above 25°C, calves will become heat stressed – to counter this, they will start to sweat in order to lose some of the excess heat. Feed intake will be reduced, while energy will be directed away from growth and the immune system to aid with cooling of the core temperature. This will reduce the growth rate of the animal and increase the risk of disease.

**Heat stress – the calf**
- At environmental temperatures above 25°C, the calf’s body temperature will rise
- In an attempt to keep cool, calves will
  - Breath quicker
  - Drink less milk and eat less feed
  - Drink more water
  - Spend longer standing and less time lying
- Energy is diverted to maintain core body temperature, making less energy available for growth
- Immune system is suppressed which reduces the calf’s ability to fight off disease

**Maintaining growth rates during warm weather**
- Invest in a thermometer for the calf building/accommodation
- Monitor temperature daily, at calf level, in the calf housing
- Observe for any calves sweating, panting or drinking excessively – if monitoring rectal temperatures, any above 39.4°C are heat stressed
- 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
Beware!

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

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

Roof lights

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

Temperature rises

In summer, when temperatures rise, remember that when you start to sweat, so do calves. Take steps to help them 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

Figure 17. Feeding hygiene
Weaning can be a stressful time in a calf’s life, often due to changes in diet, environment and social grouping. 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 solely on weight, size or age.

- Research shows that, provided calves are at least five weeks of age, concentrate intake is the key deciding factor when to wean
- 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

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

- 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

**Water**

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

**How to wean**

- Weaning should be done gradually by reducing milk fed 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:
  1. Reducing volume of milk fed per feed
  2. Feeding the same volume of liquid with a reduced amount of milk replacer per litre of water (dry matter intake)
  3. Reducing the number of feeds per day

**Reduce stress at weaning**

Stress at weaning can compromise the immune system of calves for at least two weeks after weaning, make calves more susceptible to disease, particularly pneumonia, as well as compromising growth.

Minimise changes to housing, feed, water or social groups for the two weeks after weaning.

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

![Figure 18. Examples of volume of milk replacer fed up to weaning](image-url)

Notes: This is based on the animal consuming between 0.75–1kg 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 on 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 (eg suboptimal environment)
- Maximise growth efficiency cost-effectively

Top Tips

Growth is at its most efficient in the first two 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 chest of the calf 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, you could 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.

Birth weight of the calf should be recorded as this will create a baseline figure to calculate the average daily gain, ADG (also known as daily liveweight gain, DLWG).

Then again, as regularly as possible, including

- Weaning
- One week post-weaning
- Six months of age
- At breeding

Calculating ADG

\[
\text{ADG} = \frac{\text{Last recording - earliest weight recording}}{\text{Number of days between weighs}}
\]

Example

A calf has a birth weight of 38kg, at weighing a month later it weighs 62.5kg. To calculate the average daily gain, the figures are used in the above calculation as shown at the bottom.

\[
\frac{62.5 - 38}{31} = 0.70 \text{kg per day}
\]
It is important to base your targets on a percentage of mature size (weight or height) of a number of 3rd and 4th lactation cows, 100 to 120 days in milk within the herd.

**Targets**

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

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

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.

**Example**

For a herd with an average mature body weight of 660kg, the target growth rate at different stages of growth is set out in the table below.

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

For more information on calf management please visit the web: dairy.ahdb.org.uk/calves

---

### Table 7. Target weight gains depending on age of calf

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Stage</th>
<th>Body weight (kg)</th>
<th>Target growth rate (kg/d)</th>
<th>% of mature weight</th>
<th>% of mature height</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Birth</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Post-weaning</td>
<td>112</td>
<td>0.78</td>
<td>17</td>
<td>63</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>178</td>
<td>0.77</td>
<td>27</td>
<td>74</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Pre-breeding</td>
<td>363</td>
<td>0.77</td>
<td>60</td>
<td>87</td>
</tr>
<tr>
<td>24</td>
<td>Pre-calving</td>
<td>594</td>
<td>0.77</td>
<td>85</td>
<td>96</td>
</tr>
</tbody>
</table>

Note: Weighing calves at 12 months gives a good opportunity to check the animal is on target. If they are under weight, there are 2 months to catch up before breeding.
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. There are four Cryptosporidium species which infect cattle, however the main disease causing species is C. parvum. Humans are also susceptible to infection by Cryptosporidium, when handling infected cattle. Signs of cryptosporidiosis

The lifecycle
Once ingested the parasite attaches to the gut wall and multiplies which causes damage; this reduces the calf's ability to digest food, resulting in watery scour. Whilst attached to the gut wall the parasite produces eggs, these are infectious and either re-infect the calf or are 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.

Signs of cryptosporidiosis
The main signs of cryptosporidiosis include watery yellow 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 contaminating the environment. Calves become infected when they consume these eggs by ingesting contaminated food or water. Eggs can be found in bedding, pasture, soil and water. Infected calves shed up to one million eggs per gram of faeces and it takes only a small fraction of this number to cause disease.

Farmers and stock workers can also act as potential sources of infection, making good hygiene procedures such as insisting footwear is cleaned at the farm entrance and before entering calf accommodation. The provision of clean clothing or overalls is important when trying to prevent the spread of the disease.
Take action

1. Diagnosis
Diagnosis is done by identifying *Cryptosporidium* eggs in faeces. If you have scouring calves consult your vet to get an accurate diagnosis as treatments differ depending on the bug(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 as *Cryptosporidium* does not like dry conditions

3. Implement the 3 Q's of colostrum
Quickly, Quantity and Quality. See page 3 for full information on feeding colostrum and hygiene best practice.

4. Animal Control
- Control all bugs which cause scour in young calves
- Use disinfection on 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, as 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 back with healthy calves for at least one week after scouring stops
- Feed and deal with healthy calves before sick ones

5. Prevent and Treat
- Rehydration of infected calves is key for survival. Feed 1 to 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. Allow suckler calves access to their dam at all times, if they have stopped suckling, milk and feed the calf via a teat or stomach tube if possible
- Use a licensed product for both the prevention and treatment of cryptosporidiosis (eg Halocur®) to reduce egg secretion and the severity of calf scour
- For prevention dose all new-born calves with Halocur® 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 7 consecutive days

Important
If you are using calf jackets they can potentially harbour *Cryptosporidium* eggs. These eggs can only be destroyed if the jackets are disinfected with a licensed *Cryptosporidium* disinfectant (consult data sheet for recommended contact times) and then washed according to manufacturer’s instructions and left to completely dry. See the previous section on page 21 for full information on calf jackets.

Please note: *Cryptosporidium* eggs are only destroyed above 60°C

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