

Section 1

Introduction To Calf Rearing



Introduction

The aim of calf rearing is to produce strong, healthy, well grown calves that will continue to develop steadily after weaning. The calf rearing period covers the time from birth to 12 weeks of age. It includes feeding (colostrum, milk/milk replacer, concentrates, fibre and water), housing, general husbandry and health management of calves from the moment they are born up to four weeks post weaning.

- ① Why is the calf rearing period so important?
- ② What is the 'Growth Theory'?
- ③ What does a typical 12 week calf rearing programme look like?
- ④ What are the principles of good calf rearing?
- ⑤ What are the key performance targets for the calf rearing period?

Introduction To Calf Rearing

1 Why is the calf rearing period so important?

The calf rearing period is the most crucial period for the the beef enterprise. As with any livestock system, the success of the finished animal is greatly determined by the quality and management of the newborn. We know that 50% of calf mortality within the first year occurs within the first six weeks of life, and high morbidity and mortality rates subsequently reduce farm profitability.

For beef farmers rearing calves from the dairy herd, purchasing the right calves to suit their production system, and the quality of calf management once they arrive onto the farm, are key drivers of success and efficiency on their farm enterprise.

KEY POINT:

Future predictions for 2020 envisage the national dairy herd growing to over 1.6 million cows. This will result in a significant rise in the number of calves coming from the dairy herd that are available for beef production. In response to this, the focus of attention has turned to the efficient rearing and finishing of these dairy-beef animals.

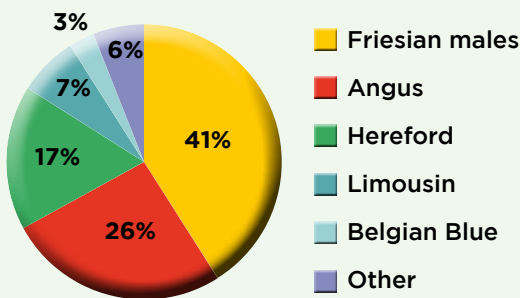


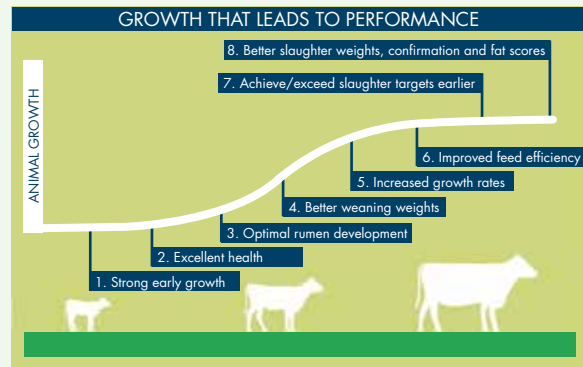
Figure 1. Sire breed profile of dairy calves available for beef production (AIM, 2016).

2 What is the 'Growth Theory'?

The growth theory reflects the importance of good calf rearing.

The theory says that growth follows an S-shaped curve, and each stage on the curve affects the next one along. So, birth weight strongly affects weaning weight, which affects weight at puberty, which subsequently affects weight at maturity.

Well reared calves will reach slaughter weights earlier than poorly grown calves, and will return more profit in a shorter time.



3 What does a typical 12 week calf rearing programme look like?

The 12-week calf-rearing programme can be divided into three phases:

Phase 1: 0-4 weeks. The calf depends on a liquid diet of milk or milk replacer and has the necessary digestive enzymes to utilise their nutrients (proteins, fat and carbohydrates) effectively.

Phase 2: 4-8 weeks. The calf is developing rumen functions and part of its daily feed will be solids. The calf's daily intake of concentrates will depend on the amount of liquid milk or milk replacer fed daily and also the palatability and digestibility of the concentrates offered.

Phase 3: 8 weeks onwards. From eight weeks of age, the calf can effectively utilise dry food and no longer depends on a liquid diet. It is vital that the calf is consuming enough concentrates before it is weaned off a liquid diet.



These calves will be consuming 1kg of concentrate for three consecutive days before weaning.

KEY POINT:

The success of the calf rearing programme depends on the stockperson's ability to optimise the 10 principles of good calf rearing.

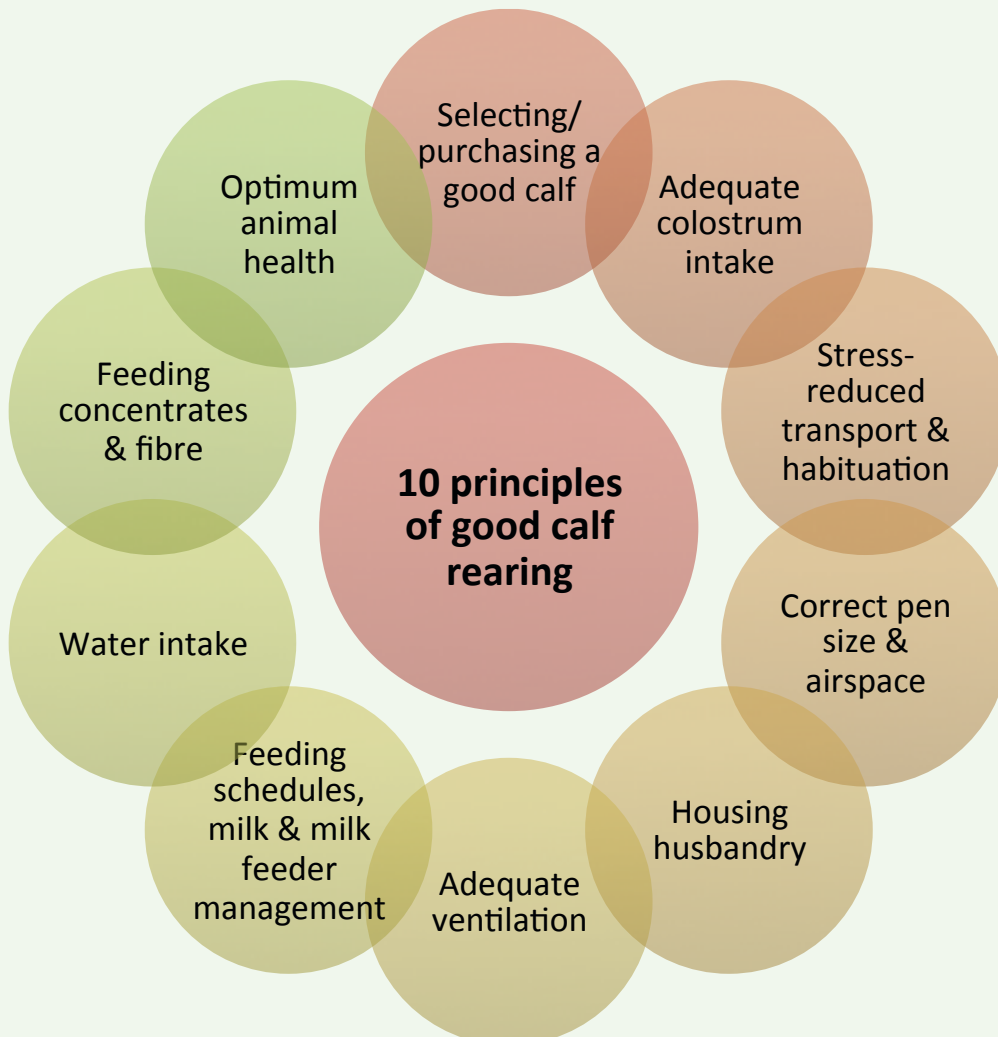
4 What are the principles of good calf rearing?

Successful calf rearing requires an understanding of the basic principles, as well as experience and good observation skills. In order for calf rearing to be a profitable exercise it must be focused on providing the correct environment and optimum nutrition for the animals to reach set growth and development targets and to meet their genetic potential.

5 What are the key performance targets for the calf rearing period?

All farmers must set targets that are achievable for their individual calf rearing enterprise. Ideally farmers should aim to achieve:

- Double calf birth weight by eight weeks i.e. 40kg to 80kg in 56 days.
- Growth rate of 700-800g/day.
- Calf mortality of <3% over the 12 week period.
- Less than 10% calf morbidity (incidences of disease).





Section 1

Care of The Newborn Calf



Introduction

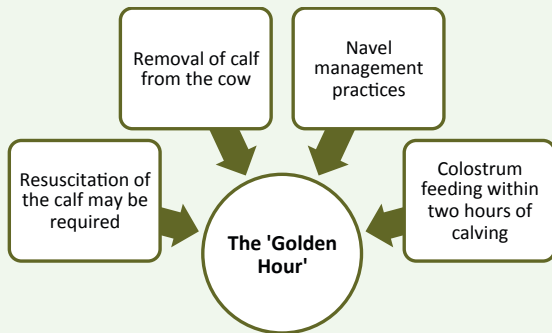
The most critical period of a calf's life is the first hour after birth, termed the 'Golden Hour'. Correct calf management and feeding practices during this time influence the subsequent health and development of the calf throughout its life, and its overall lifetime performance.

- ① What must take place during the 'Golden Hour'?
- ② Assessment of newborn calf vitality.
- ③ Calf resuscitation.
- ④ Removing the calf from the cow.
- ⑤ Successful umbilical care.

Care of The Newborn Calf

① What must take place during the 'Golden Hour'?

During this crucial one hour period the following actions must take place:



Delaying any of the above can result in an increased risk of calf disease incidence and mortality.



The 'Golden Hour' begins once the calf has fully emerged.

② Assessment of newborn calf vitality.

An assessment of the calf's vigour should be made immediately after calving. The following individual indicators should be monitored: responsiveness to external stimuli, muscle tone, sucking reflex, the time it takes for the calf to lift its head and the time to first standing.

Table 1. Normal time frames for some indicators of calf vigour.

Vigour Indicators	Minutes post calving
Lift its head	3
Attain sternal recumbency *	5
Attempt to stand	20
Stand spontaneously	60-90

* sitting up on the brisket with the legs tucked under the body



This calf has attained sternal recumbency (sitting up with its legs tucked in under its body).



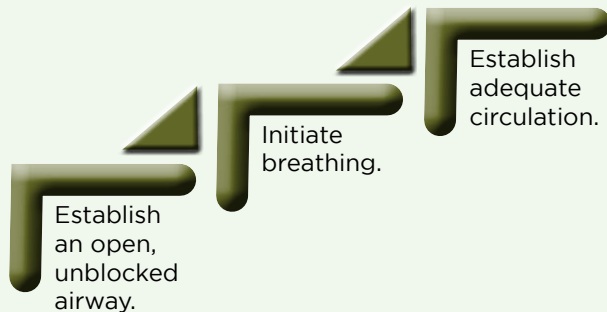
The calf should have attempted to stand within 20 minutes of calving.

③ Calf resuscitation.

In general, most calves will not require resuscitation. However, calves that experience difficult or problem births may benefit from resuscitative care during and/or immediately after calving. In order to identify calves that need resuscitation the farmer must be present at the calving and look out for signs of calf distress.

Identification of high risk calves requiring resuscitation (Animal Health Ireland)		
Before Birth	During Birth	After Birth
Identified by the predicted likelihood of a problem calving (premature, wrongly presented calf, twins, slow calving, tight calving, hard calving).	Identified by large limbs, swollen tongue or head, bluish gums and muzzle, yellow/brown/red stained birth fluids and poor reflex response to pinching between the hooves.	Identified by lack or absence of breathing, gasping or bellowing, lying flat, unable to lift the head, slow to sit up, stand and to suck.

The cornerstones to successful calf resuscitation are:



HOW TO:



Perform successful calf resuscitation

- Suspend the calf upside down for a short period of time (never longer than one minute).
- Pour cold water over the calf's head and/or stick a straw or finger into its nostrils.
- Sit the calf upright on its chest.
- Dry off very weak, cold, wet, shivering calves and place them under an infra-red lamp.
- Consult a vet regarding other resuscitative options such as stimulant products.



Rubbing down the calf can help to initiate breathing.

Care of The Newborn Calf

④ Removing the calf from the cow.

When born, a calf is immediately at risk of picking up infections via the navel, mouth and nostrils from the calving environment, the cow and any other animals in the same airspace. In addition, if the calf is left with the mother, you cannot be sure how much colostrum the calf has received or when they received it.

Because of this, the calf should be removed ('snatched') from the cow immediately after birth and placed in a clean, freshly-bedded area where it can be fed the correct amount of colostrum by bottle feeding or stomach tubing.



A calf barrow should be used to transport the calf from its birth location to a calf pen.

⑤ Successful umbilical care.

The spread of infection from the environment into the calf via the navel cord is the cause of navel or joint ill (see section 6, Calf health). Preventing navel ill is based on a number of farm hygiene and calf care/immunity principles that must be optimised at and shortly after birth.

In the first week of life, the navel should be checked for excessive bleeding, pain, abnormal swelling, odour or pus, and treated as recommended by your local vet.

If a farm has recurring navel ill problems and already practices navel cord dressing, altering the procedure (e.g. change from iodine to chlorhexidine, changing from a teat dip to a navel dip solution, dipping instead of spray), may help to prevent navel ill. If navel issues continue, stop cord dressing altogether and focus instead on optimising calf immunity and calving hygiene.

HOW TO:



Prevent navel ill

- Good maternity pen hygiene. Ensure calves are born in a clean, freshly bedded calving unit.
- Minimise the length of time a calf spends in calving pens.
- Ensure adequate early intake of good quality colostrum (Colostrum 1,2,3 rule, see chapter 3).
- Practice navel hygiene.
- Practice antisepsis (chlorhexidine or iodine) if navel ill is a problem on farm and hygiene is already optimal.
- Check the calf regularly for signs of navel ill.



Disinfecting the navel is a key task in the first minutes of the calf's life.

Section 1

Colostrum Feeding of the Newborn



Introduction

Colostrum management is the single most important management factor in determining calf health and survival. All calves must receive sufficient colostrum immediately after birth to support their growth and optimise their welfare. Calves that do not receive adequate quantity or quality colostrum in the right time frame will be compromised and more likely to contract infection.

- ① What is colostrum?
- ② What is different about colostrum compared to normal milk?
- ③ Why is colostrum important?
- ④ How much colostrum should be fed?
- ⑤ How is colostrum quality assessed?
- ⑥ How do you determine if the calf has received sufficient colostrum?
- ⑦ What factors affect the transfer of immunoglobulins?
- ⑧ What factors affect the level of immunoglobulins in colostrum?
- ⑨ Colostrum contamination.
- ⑩ Can colostrum replacers be used?
- ⑪ How do you store colostrum?

Colostrum

Feeding of the Newborn

① What is colostrum?

Colostrum is the first milk produced by the cow. The next two to eight milkings are called 'transition milk'.

② What is different about colostrum compared to normal milk?

Unlike whole milk, colostrum contains many important substances for calf health such as immunoglobulins (antibodies), energy, cytokines, growth factors, and increased levels of vitamins and minerals. In addition, colostrum has a higher fat and protein content than whole milk.

Table 2. The difference in nutrient composition between colostrum, transition milk and whole milk.

	Milking number			
	1	2	3	11
	Colostrum	Transition milk		Whole milk
Total solid, %	23.9	17.9	14.1	12.5
Fat, %	6.7	5.4	3.9	3.9
Protein, %	14.0	8.4	5.1	3.1
Antibodies, %	6.0	4.2	2.4	0.09
Lactose, %	2.7	3.9	4.4	4.9
Minerals, %	1.11	0.95	0.87	0.74
Vitamin A, µg/dL	295	190	113	34



Colostrum (right) is far richer than subsequent milk (left) and contains valuable immunoglobulins to protect the calf against disease.

③ Why is colostrum important?

A calf is born without protective immunoglobulins/antibodies to protect it against disease. Colostrum is an extremely rich source of these antibodies. The calf depends on the successful passive transfer of these maternal antibodies from the colostrum in order to defend itself against infection until its own active immunity begins to work.

KEY POINT:

Calves that do not receive colostrum are at an increased risk of developing scours and 74 times more likely to die in the first 21 days of life.

Immunoglobulin status of dead or sick calves

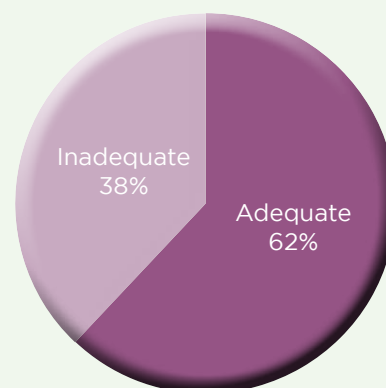


Figure 2. Zinc sulphate turbidity test results from AFBI and DAFM (2015). Adequate colostrum immunity is defined as a ZST result ≥ 20 units.

4 How much colostrum should be fed?



By feeding calves colostrum by bottle or stomach tube you can be sure of the quantity they have consumed.

The first feed of colostrum should be **at least three litres**. This should be fed within the first two hours of birth. This provides the calf with immunity to disease before pathogenic organisms can become established in the calf's gut.

Another guide to colostrum feeding is calf birth weight. As this varies depending on breed and gestation length the rule is to feed 8.5% of their birth bodyweight for their first feed (e.g. 35 kg calf requires three litres).

An easy way to remember the best practise for colostrum feeding is the 'Colostrum 1,2,3' rule from Animal Health Ireland. (See Colostrum Management, http://animalhealthireland.ie/?page_id=387)

5 How is colostrum quality assessed?

Colostrum quality is measured by the amount of immunoglobulin G (IgG) it contains. IgG concentration must be greater than 50 g/L. The quality of colostrum is highest when collected immediately after the cow calves, with the immunoglobulin content halved by the second milking

Rating	Measure of quality (milligrams of IgG in each ml of colostrum)
Very good	60 mg/ml
Good	50 mg/ml
Poor	30 mg/ml

If colostrum quality is poor, it should not be used for the calf's first feed. Instead it can be fed as the calf's second or third feed.

Most on-farm methods involve the indirect measurement of colostrum quality by using either a Brix refractometer or colostrometer. Visually assessing colostrum is not an accurate method of determining its quality.

Colostrum 1 - 2 - 3 for dairy calves

1 Use colostrum from the **first** milking for the first feed

2 Give colostrum within **two** hours from the calf's birth

3 Give at least **three** litres

Colostrum

Feeding of the Newborn

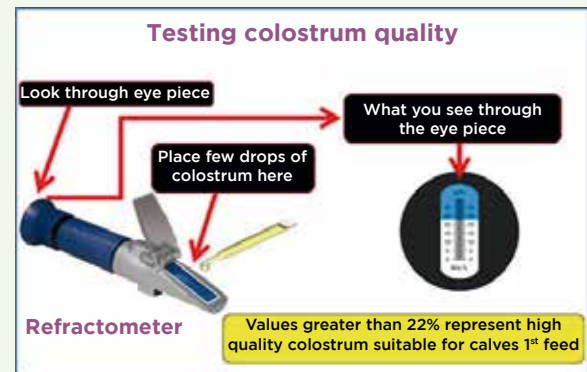
KEY FACTS:

Calves left to suckle the dam are less likely to receive adequate transfer of immunity.

Brix refractometer	Colostrometer
<p>A refractometer is a pocket sized device that uses light to determine the density of a liquid.</p> <p>For measuring colostrum, a refractometer calibrated in the Brix scale is used and values are read as a percentage.</p> <p>Brix refractometers are quite accurate in measuring IgG levels in colostrum.</p> <p>A score of 22% is the cut off for detecting good quality colostrum (fresh or frozen) that can be fed to calves for their first feed.</p>	<p>A colostrometer is a device which floats in a sample of colostrum and measures the specific gravity.</p> <p>As a rule, the more IgG in the colostrum the denser it will be and the higher the specific gravity reading. This means the colostrometer will float higher in a good sample and lower in a poorer sample.</p> <p>Colostrometers tend to overestimate the quality of colostrum. In addition, colostrometer readings are affected by temperature, frothiness of the sample and the fat/total solid content.</p>



A Brix refractometer is used to indirectly evaluate the level of immunoglobulins in colostrum.



6 How do you determine if the calf has received sufficient colostrum?

If calves do not get enough colostrum soon after they are born, they will have failure of passive transfer (FPT) of antibodies. Failure of passive transfer markedly increases calf morbidity (disease incidence) and mortality in calves, therefore being able to determine if a calf has received adequate antibody protection from colostrum is extremely useful.

This can be done by measuring the Ig levels in calf blood serum. The Zinc Sulphate Turbidity Test is routinely used by the Department of Agriculture, Food and Marine's Regional Veterinary Laboratories to detect FPT. The results of this test are measured in ZST units.

KEY QUESTION:



Should calves be fed pooled colostrum?

Research has shown there is no difference in calf serum IgG or calf weight gain between calves fed pooled (mixed colostrum from various sources) or individual dam colostrum. However, feeding pooled colostrum is a biosecurity risk and should be undertaken with careful consideration and extreme caution. Pooling of colostrum can lower colostrum quality due to dilution, therefore only pool "like with like", i.e. high quality with high quality.

7 What factors affect the transfer of immunoglobulins?

The transfer of immunoglobulins to the calf depends on a number of factors including:

- The quality of the colostrum.
- The calf's ability to absorb IgG (affected by the length of time from birth to first feed).
- The volume of colostrum ingested.

The ability of the calf to absorb IgG is highest in the first two hours after birth, but after six hours this ability progressively declines. The calf's absorptive ability completely ceases 24 hours after birth. Therefore, the earlier a calf is fed after birth, the greater the level of IgG absorption.

KEY TIPS:



Continuous feeding of smaller amounts of colostrum and/or transition milk throughout the first two weeks of life is often practiced, and has been associated with reduced diarrhoea in dairy calves.

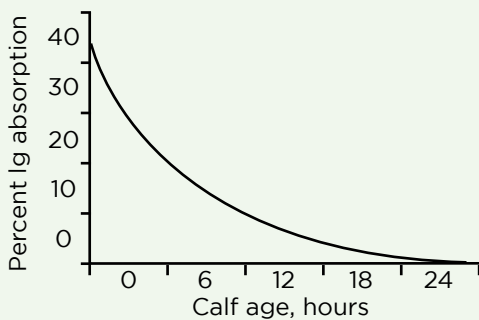


Figure 3. Reduction in immunoglobulin absorption with increasing calf age. Adapted from Blomquist, 2009.

8 What factors affect the level of immunoglobulins in colostrum?

There are a number of factors that influence the volume and the immunoglobulin concentration of the colostrum from a dairy cow. These include:

- Lactation number/parity.
 - First and second lactation cows produce colostrum with a lower IgG concentration than cows in their third and fifth lactation.
- Breed of cow.
- Length of the non-lactating period (if less than three weeks).
- Time interval from calving to first milking
 - Colostrum harvested later than nine hours post-calving has a lower IgG concentration than colostrum harvested before this time.
 - Colostrum produced by cows that are milked up to six hours post-calving has the greatest mean IgG concentration.
- Month of calving.
 - Later calving cows (April/May) produce colostrum with a lower IgG concentration than cows calving in the earlier spring months or in the autumn months.
- Colostral weight.
 - Colostral IgG concentration decreases linearly with increasing colostral weight (1.7g/l per kg increase).

KEY POINT:



Research has shown that colostral IgG concentration decreases by 3.7% each hour post calving.



Stomach tube a calf

Where calves are weak or poor drinkers, stomach tubing is a quick and efficient method of getting colostrum into the calf. It is not uncommon for farmers to stomach tube all calves immediately after birth. Great care must be taken as incorrect stomach tubing can severely damage the calf and can be fatal.

The process of stomach tubing



1. Determine the correct length of tube by measuring the distance from the tip of the calf's nose to the point of its elbow behind the front leg, usually 45 cm or more.



2. The tip of the stomach tube should be smooth and not damaged or sharp. Place the tube in warm water to make it more pliable. Dip the tube into a lubricant, such as vegetable oil, and dip the tip of the tube into colostrum.



3. Once the calf's mouth is opened, the empty tube is passed slowly along the tongue to the back of the mouth. Aim to the left side of the throat. When the tube is over the back of the tongue, the calf starts chewing and swallowing it and the tube is then passed down into the oesophagus.

Never force the tube; if it is being done correctly it should slide in easily.



4. If the tube is properly positioned, the rings of the trachea (leading into the lungs) and the rigid enlarged oesophagus can be felt easily. The exposed end of the tube should be checked for spurts of air, which indicates that the tube has gone into the lungs.



5. Once in place correctly, the tube can be unclipped or straightened out or the container can be tipped up to allow liquid to flow down into the stomach. Liquids should be at body temperature (38°C) to prevent shock and to optimise antibody absorption. It can take three minutes or more to allow sufficient fluid to be administered. The calf will regurgitate less with a slow flow rate.



6. When feeding is finished, the tube should be slowly removed. The tube should be cleaned and sanitised, then allowed to drain and dry.



9 Colostrum contamination.

Bacterial contamination of colostrum often occurs on farms, with two associated concerns:

1. The risk of transfer of infection to calves.
2. Decreased absorption of IgG in the intestines.

Calves fed colostrum with extremely high levels of bacteria (>1,000,000 cfu/ml) have decreased serum IgG concentrations at 24 hours, whereas calves fed colostrum with bacteria levels of 100,000 cfu/ml achieve adequate passive transfer

KEY POINT:

Best practice suggests that the total bacterial count of colostrum should not exceed 100,000 cfu/ml and faecal coliforms should be below 10,000 cfu/ml.

HOW TO:

Achieve desirable bacterial counts in colostrum

Desirable bacterial counts can be achieved through hygienic colostrum collection, avoiding bacterial contamination, immediately refrigerating or freezing surplus colostrum or implementing heat treatments of colostrum. Storage of colostrum at room temperature increases the growth of bacteria.

Heat treatment (pasteurisation) of colostrum at 60°C for 30 or 60 minutes reduces the bacterial count, preserves IgG concentration and increases the apparent efficiency of absorption of IgG compared to calves fed raw colostrum. In addition, calves fed heat treated colostrum are at lower risk of illness.

10 Can colostrum replacers be used?

The ideal source of colostrum is the calf's own dam for two main reasons:

- i) Concerns regarding the potential spread of Johne's and other diseases.
- ii) The calf will acquire immunity to fight pathogenic organisms encountered on the home farm.

Next best to the calf's own dam is colostrum from cows in the same herd. Seek advice from your vet if you do not wish to use or have insufficient maternal colostrum on your own farm.

Colostrum replacement products (CR) are available. However whey protein concentrate (WPC), used as a colostrum substitute, is less effective in preventing neonatal morbidity and mortality. Additionally, the ability of commercial CR to prevent FPT in calves is inconsistent. Therefore colostrum replacers should only be used as a last resort, and freezing any excess high quality colostrum should be routine on farm.



Table 3. Colostrum versus colostrum replacer: first 29 days of life.

Variable	Colostrum	Colostrum replacer
Total DMI, kg	15.7	13.7
Milk replacer DMI, kg	10.7	9.8
Starter DMI, kg	5.0	3.9
Feed efficiency (gain:feed)	0.43	0.22

Source: Jones et al. JDS 2004.

11 How do you store colostrum?

Colostrum can be stored at 4°C for two days without negatively affecting the absorption of colostral IgG by the calf. Storing colostrum at any higher temperature leads to decreased absorption of IgG due to an increase in bacterial contamination.

Colostrum Feeding of the Newborn



Frozen colostrum can be stored at -18 to -25°C for at least a year without changing its quality.

HOW TO:

Thaw colostrum

Colostrum must be slowly thawed at temperatures below 50°C, i.e. in a water bath, in order to not affect its quality. Cold, refrigerated colostrum should be warmed in a water bath before feeding. This helps increase antibody uptake by the calf.

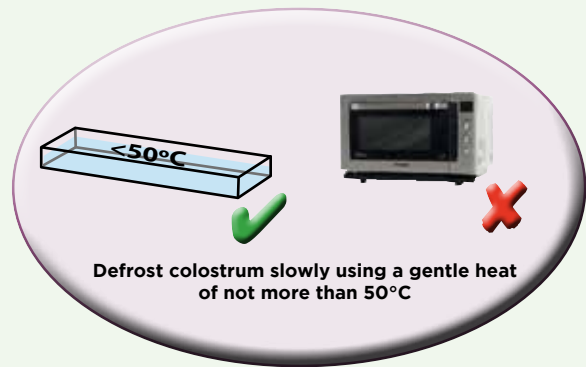


Colostrum should be thawed (if necessary) and warmed to body temperature (38°C) in warm (maximum 50°C) water.

A microwave should not be used to thaw colostrum as it can cause slight coagulation of the proteins in the colostrum. In addition, lower volume and total protein content are associated with microwave thawed colostrum.

KEY POINT:

Temperatures above 50°C cause colostrum proteins, including immunoglobulins, to denature. Therefore, colostrum should never be thawed in boiling water.



Colostrum checklist

- Always remember- Colostrum 1, 2, 3!
- The calf's own mother is the ideal source of colostrum.
- Stomach tubing is a successful method of colostrum administration.
- Colostrum can be stored at 4°C for two days.
- When the colostrum is frozen, thaw slowly in water bath <50°C.
- Limit colostrum contamination for maximum IgG absorption.

The four Qs of colostrum feeding

Quality	Quantity
<ul style="list-style-type: none"> • Measure IgG levels • Review factors influencing quality • Maintain good hygiene • Feed or freeze quickly 	<ul style="list-style-type: none"> • Feed a minimum of three litres per calf
Quickly	Quietly
<ul style="list-style-type: none"> • Feed within first six hours (ideally within two hours) 	<ul style="list-style-type: none"> • Minimise stress to maximise IgG absorption