Colostrum Management: Giving calves a great start to life

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Key Findings

- **Failure to absorb enough immunoglobulins from colostrum in the first 24 hours of a calf’s life can make a calf susceptible to disease and death.**
- **This failure, known as Failure of Passive Transfer (FPT) is relatively common.**
- **Farmers can test for prevalence of FPT and for the quality of their cows’ colostrum.**
- **Good management practices can limit the chance of FPT.**

Rearing healthy and productive replacement stock is the key to future productivity of a herd. Improving calf health involves increasing the calf’s immunity to be able to resist infection as well as reducing the risk of an infection occurring.

Calves are born with a poorly developed immune system. This is because (unlike in humans), the bovine placenta prevents the transfer of large immunoglobulin molecules (antibodies), essential for immunity, from crossing the placental-blood barrier. Therefore, calves must absorb immunoglobulins, from colostrum, across the intestinal wall to obtain immunity until their own immune system becomes functional. This process is most effective in the first 24 hours after birth and is often referred to as ‘passive transfer’. When calves receive sufficient quantities of good quality colostrum, there are measurable, sufficient concentrations of immunoglobulin in their blood (>10mg/ml). Calves that fail to absorb sufficient quantities of immunoglobulin in those first 24 hours are said to have suffered from Failure of Passive Transfer (FPT).

FPT can result in increased mortality rates, disease and ill-thrift in dairy calves and has been associated with long-term reductions in animal productivity. It is associated with a greater susceptibility to diarrhoea and respiratory disease in young calves as well as septicaemia and enteritis. FPT can also lead to under development of the digestive tract and lower feed intake resulting in reduced growth and milk production.

The prevalence of FPT in calves has been reported as being 19-40% worldwide. In 2015, a study using 4000 dairy calves from 9 different regions across New Zealand indicated that the average prevalence of FPT at various intervals during the spring calving period was 33%, with prevalence on farm ranging between 5% and 80%. This indicates many calves are not getting enough good quality colostrum soon enough after birth to ensure passive immunity.
Why do calves get failure of passive transfer?

Colostrum immunoglobulin G (IgG) concentration, timing and volume

High quality colostrum contains ≥50 mg/mL IgG. Calves must ingest a minimum mass of 100g of immunoglobulin to ensure adequate passive immunity\(^\text{11,12}\). Furthermore, over the first 24 hours of life the intestine of the neonatal calf becomes increasingly impermeable to large immunoglobulin molecules so timing of colostrum feeding is crucial. Feeding colostrum too late is a contributor to FPT\(^\text{1,11}\).

Inadequate colostrum IgG concentration, inadequate volume of colostrum and feeding colostrum too long after birth are all major contributors to FPT.

| Calves should be fed 10-15% of their bodyweight of high quality colostrum within six to twelve hours of birth to get enough protective antibodies. For a 40kg calf this is 4-6 litres of colostrum. First colostrum needs to be split into 2 feeds since the abomasal (calf stomach) capacity is only 1.5-2 litres. Fresh “gold” colostrum is best (Gold colostrum is the best quality colostrum taken from the first milking after a cow calves). |

Bacterial contamination of colostrum

While colostrum IgG concentration and volume may be adequate, bacteria may contaminate colostrum at harvest, during storage or at feeding. These bacteria can limit the absorption of IgG and lead to a reduction in passive transfer and lower serum IgG concentrations\(^\text{12,13}\). Coliforms (bacteria from faecal material) are the most detrimental of the bacteria for IgG absorption\(^\text{12}\). It is likely that the effects of bacteria are due to them:

- binding to IgG in the gut lumen reducing the total mass of IgG available for absorption
- inducing sloughing of absorptive neonatal intestinal cells
- interfering with IgG receptors on intestinal epithelial cells by competition for and blocking of IgG receptors\(^\text{12,13}\).

Godden et al (2012) also suggested that damage to the epithelial cells may result in accelerated gut closure by replacement of the permeable neonatal intestinal epithelial cells with mature cells, incapable of macromolecular (IgG) uptake\(^\text{12}\).

Good hygiene practices need be used at all stages of colostrum harvesting and handling to minimise risk of bacterial contamination.
Why can feeding enough high quality colostrum be a challenge?

- Time and staffing constraints at calving time can make it difficult to ensure new-born calves receive enough high quality colostrum shortly after birth. This is can be worse with highly compact calving patterns where time is in even shorter supply. Dairy calves are normally removed from the dam within 12 to 24 hours of birth, which may be too late to get quality colostrum ingested before the intestines stop absorbing IgG (if the calf has not received adequate colostrum from its mother). The 2015 study of 105 dairy farmers showed that only 22% pick up calves twice a day.

- Colostrum IgG concentrations and colostrum volumes are extremely variable in dairy cattle, ranging from <2-200mg/ml and from 2.8 to 26.5 litres\textsuperscript{14, 15, 16}.

- Pooling colostrum is common practice on New Zealand dairy farms. This practice can be problematic, as individual cow variation can result in pooled colostrum that has low IgG concentrations (<50mg/ml), predisposing calves to FPT.

- In the 2015 study, colostrum quality was found to be poor. Only 9.7% of the 298 colostrum samples collected at multiple times during the calving season had IgG concentrations over the recommended levels and only 11% of samples had acceptable bacterial contamination levels. Only 3.4% of samples met both thresholds for bacto and coliform counts\textsuperscript{17}.

Leaving the calf on its mother versus tube-feeding

Leaving a calf with its mother should ensure it gets fresh, warm, high quality colostrum very soon after birth, right? Not necessarily. National and international work suggests that:

- The risk of FPT is higher when calves are left to suckle dams compared with when they are removed promptly (with the first 6-12 hours of life) and fed enough (10-15% of bodyweight), high quality colostrum (>50mg/ml IgG) in the calf shed. This is possibly attributable to delays in suckling and failure of the calf to voluntarily consume enough colostrum\textsuperscript{6, 18} if left on its mother.

- If colostrum feeding and storage equipment is hygienic and pooled colostrum is ‘clean’ (low bacteria counts) and managed well; calves may be more likely to get health problems, such as diarrhoea, when left to suckle dams, since the mother is a source of infection.

- Tubing animals means calves get a known quantity of colostrum within a known time frame. However, recent research also questions this management method:

  - Tubing can result in a lack of promotion of oesophageal groove closure leading to milk pooling in the rumen with resultant malabsorption and bacterial overgrowth. This leads to a poorer IgG absorption.

  - Tube feeding poor quality, contaminated colostrum will increase the risk of FPT occurring.
Testing for failure of passive transfer

Regardless of whether calves are left on their mothers, every calf is tube fed or calves are put onto feeders, the following management steps can be taken to measure and prevent FPT:

**Step 1: Test your calves for FPT**

You can test for the prevalence of FPT by blood sampling 12 healthy calves (not scouring or dehydrated), between 24 hours and 7 days of age, for laboratory analysis of total protein. It is recommended that this is done both at the beginning and peak of calving when the prevalence of FPT is typically higher.

Concentration of total protein provides a good estimate of IgG\textsuperscript{10}. Various cut points have been used to classify if a calf has FPT, but the most commonly used cut-off is \textless;52g/L of total protein.

**Step 2: Test colostrum for quality**

You can use a BRIX refractometer to test your colostrum quality. BRIX readings of \textgreater;22% are indicative of high quality (high IgG) colostrum. You can start by testing the pooled colostrum. If this is of poor quality you will need to test individual cows as they will give very different results. This takes only 5 seconds using a BRIX refractometer and can be easily worked into your management protocols.

To combat FPT, regardless of your management system, test to ensure your calves are getting enough high quality colostrum within the first 24 hours of life.
**Best practice management of calves**

Regardless of your FPT status, following best practice calf rearing will ensure your future herd gets the best start in life. If you do have an FPT problem, rigorously evaluate your processes to determine where the risk(s) lies so you can eliminate the cause.

Feed new-born calves 10 to 15% of their bodyweight (4 to 6L for a 40kg calf) in “gold” colostrum within the first 6 to 12 hours of life\(^4\). Gold colostrum is the best quality colostrum taken from the first milking after a cow calves. Be aware that the calf abomasum has a limited capacity of approximately 1.5 to 2 litres so you may need to give smaller feeds more frequently (i.e. two feeds within the first 12 hours of life).

You can test the quality of colostrum from individual cows and only feed new-born calves gold colostrum from cows that have BRIX readings of over 22%. If pooling colostrum, select only healthy cows as sick cows and heifers may have poorer colostrum IgG levels. Be aware that pooling colostrum increases the risk of infecting calves with contagious diseases such as Johnes.

Bacterial contamination of colostrum can occur at any stage from harvesting (from the cow), to storage and feeding. As bacteria can inhibit IgG absorption in new-born calves, all storage and feeding equipment needs to be kept clean. Use hot soapy water to clean all equipment and buckets, as this will remove colostrum fatty residues.

Colostrum should be stored in a lidded drum or vat and stirred regularly. Ideally, colostrum should be refrigerated (at 4\(^0\) C) to suppress growth of bacteria\(^{20}\) and help preserve IgG concentrations\(^{14}\).

If refrigeration is not possible, add a chemical preservative agent to the colostrum such as potassium sorbate at a rate of 1% by volume of a 50% solution. More traditional chemical preservatives, such as formaldehyde and hydrochloric acid are not recommende for use in the food producing industry as they are known carcinogens. Easiyo probiotics, are also not recommended because they do not preserve IgG or prevent bacterial proliferation. Colostrum should be fed within 2-3 days of collection.

Continuing to feed colostrum to calves beyond the initial 24 hours (after the calf gut ‘closes’) may also have advantages, as IgG can bind to infectious agents in the gut, limiting disease prevalence and severity\(^{21,22}\). It is also a highly nutritious feed.

Vaccinating your herd 3-6 weeks before planned start of calving with a product such as Rotavec or Scourguard will boost specific antibody levels in colostrum.

**More research underway**

Further research is underway by VetEnt and Anexa FVC to determine the association between FPT and disease, as well as production and reproduction outcomes. This research is funded by the Sustainable Farming Fund and DairyNZ Inc. and is designed to help farmers and veterinarians make informed decisions about the prevalence, management and effects of FPT. IgG levels in colostrum.
References


17. Denholm et al, unpublished observations


