Colostrum Hygiene

Introduction

Passive immunity obtained from colostrum is the only source of early immunity in newborn calves, due to the inability of the placenta to transfer immunoglobulins in utero. The immune status of calves in the pre-weaning period depends directly on the quantity and quality of colostrum ingested during the first few hours of life.

Failure of passive transfer is often assessed by measuring blood serum immunoglobulin, (IgG) concentration 24-48 hours after birth, with less than 10mg/ml IgG considered inadequate. Calves with blood serum levels below 10mg/ml are at greater risk of developing disease during the milk feeding period.

Another indirect measure of the adequacy of colostrum transfer is the zinc sulfate turbidity test, which can be carried out using blood samples from calves at ~1 week old; results of over 20 units indicating adequate passive immunity. Serum (from blood) total protein, (STP), measured by refractometer is another quick and easy way to determine calf immune status and can be done easily and quickly by a veterinarian on farm.

Bacterial contamination of colostrum can occur at any stage during the collection, storage and feeding process.

Whilst there are different ways to measure bacterial contamination, such as total bacterial count, (TBC), which will be familiar to dairy farmers, the important point to remember is that high levels of bacteria in colostrum as fed, can have a negative impact on the absorption of IgG's into the blood stream of newborn calves and hence, it is important to minimise the risk of contamination at all stages of the process from cow to calf.

Survey of colostrum contamination on farms (summary)

Location	Sample Size	Results	Comment
Victoria, Australia	24 farms, 240 samples	58% < 100,000 cfu/mL* total plate count 94% < 10,000 cfu/mL total colony count 23% met all hygiene and quality standards	Large number of calves at risk of failure of transfer of passive immunity
N. Ireland (AFBI)	21 farms, 1239 samples	81% > 100,000 cfu/mL total viable count 44% < 50mg/mL IgG content	High levels of contamination
USA	67 farms in 12 states, 827 samples	43% > 100,000 cfu/mL total plate count 16% > 100,000 cfu/mL total plate count 39% met all standards for plate count and IgG content	Contamination negatively associated with passive transfer of immunity
Ireland	Colostrum stored at	Colostrum storage at room temperature or in fridge. Rapid	No impact on IgG content,

(Teagasc)	ambient or 4^0C	increase in total bacterial count in 1st 6 hours, (5%), irrespective of storage temperature, 2% increase in next 18 hours. Refrigerated samples: no more growth 24-48 hours, then restarted to growth at similar rate as samples stored at ambient temperature	but colostrum was not fed to measure impact on calves
Ireland (Teagasc)	Colostrum stored at 4, 13, or 20^0C for up to 72 hours	Rapid increase in total bacterial count in 1^{st} 6 hours, irrespective of storage temperature. Samples at 13 and 20^0C continued to grow up to 72 hours	No impact on IgG content, but colostrum was not fed to measure impact on calves
Ireland (Teagasc)	5 treatments	Fresh pasteurised colostrum, Fresh unpasteurised colostrum, Unpasteurised stored 4^0C for 2 days, Unpasteurised stored 13^0C for 2 days, Unpasteurised stored 22^0C for 2 days. Increase in TBC with unpasteurised colostrum and storage temperature	No difference in IgG content, but TBC had negative impact on calf serum IgG content

Preserving fresh colostrum with potassium sorbate

A US study assessed bacterial contamination of colostrum from collection to feeding and during storage, under a number of different regimes. The researchers found that colostrum collected aseptically from the udder, (41 cows), had very low bacterial counts, with 100% of samples having a Total Plate Count (TPC) < 100,000 cfu/mL. However, bacterial counts were significantly increased in collection containers and in the stomach tube for feeding.

Four treatments were applied to colostrum from these cows, following milking with a (sterilised) mobile milker:

a) samples stored in a refrigerator (4^0C) for 24, 48 or 96 hours,

b) samples stored at ambient temperature for 24, 48 or 96 hours,

c) samples stored in a refrigerator with 5% potassium sorbate for 24, 48 or 96 hours,

d) samples stored at ambient temperature with 5% potassium sorbate for 24, 48 or 96 hours.

Storage time and temperature had no significant impact on bacterial growth, with the exception of refrigerated samples with added potassium sorbate. These samples had decreased Total Plate Count (TPC) at 24 hours, compared to 0 hours and remained low for the duration of the experiment, (96 hours). Non-treated refrigerated samples had delayed bacterial growth, but by 48 hours, there were no significant differences in TPC or Total Coliform Count between refrigerated samples and those stored at ambient temperature. Hence, the benefits of refrigeration were short lived. The researchers concluded that the udder should be aseptically clean before milking colostrum, vessels should be sterilised before use and if colostrum is to be stored, it should be refrigerated immediately, ideally preserved with an additive such as potassium sorbate

Heat Treatment of Colostrum

Heat treatment/pasteurisation of colostrum is one method to reduce bacterial load before feeding. However, the temperature and time of treatment is important, as proteins such as IgG's are easily denatured by heat. High temperature, short time continuous flow pasteurisation, (72 °C x 15 sec), which is normal for creamery milk, results in severe thickening or congealing of colostrum and partial degradation/denaturing of the proteins. Batch treatment at 600C for up to 1 hour maximum seems to be an adequate compromise, both to maintain IgG content, while also reducing bacterial contamination.

What does the research say on heat treatment?

A US study in 2007 sought to find out the impact of pasteurisation, (60^{0}C for 1 hour), on bacterial counts and IgG concentration and then to assess the impact of passive immunity in calves following ingestion. Pasteurisation had no significant effect on IgG content, (72.6 vs 67.3 mg/mL), but greatly reduced Total Plate Count, even though it was well below 100,000 cfu/mL in the unpasteurised colostrum. Blood taken at 24 hours showed that calves fed pasteurised colostrum had significantly higher circulating STP levels, (6.3 vs 5.9 g/dL). Apparent efficiency of absorption, (AEA), in calves fed pasteurised colostrum was 35.6% compared to 26.1% in calves fed unpasteurised colostrum. It was postulated that the reasons for these results could be that; a) antibodies bind pathogens in the gut before absorption can occur; b) bacteria can bind to receptors on enterocytes, (intestinal absorptive cells), reducing the number available of receptors available for IgG uptake.

A 2009 US study examined the impact of feeding fresh unpasteurised colostrum, (low bacterial content), feeding after 24 hours at 200C, (high bacterial content), or feeding following pasteurisation of fresh colostrum. There was no difference in serum IgG levels at 48 hours between low and high bacteria treatments, but pasteurisation increased serum IgG levels, compared to either the low or high bacteria treatments. It was concluded that heat treatment, (600C for 30 minutes), reduced bacterial concentration, but maintained IgG concentration, leading to higher circulating IgG levels and higher AEA%. High bacterial load did not interfere with IgG absorption, as colostrum quality was very high, (69.6mg/mL IgG).

A 2015 US study examined the impact of pasteurisation and bacterial contamination on AEA, (see Table 1). They found that pasteurisation had no significant effect on circulating IgG levels, but bacterial contamination had a significant effect on passive transfer, even in calves fed pasteurised colostrum. The results may have been influenced to some extent by the very high-quality colostrum available, ~70 mg/mL IgG.

Table 1. Impact of low and high bacterial contamination of colostrum, combined with either no pasteurisation or pasteurisation on transfer of passive immunity to newborn calves.

Treatment	Unpasteurised		Pasteurised	
Bacteria	Low bacteria	High bacteria	Low bacteria	High bacteria
Serum IgG	20.19	10.72	20.97	8.79
Serum total protein	8.24	7.38	8.32	7.22
AEA %	33.70	14.74	33.42	13.88

Another US study assessed pasteurisation of colostrum and concluded that STP levels were significantly higher in calves fed pasteurised colostrum, (18.0 vs 15.4 mg/mL) and that calves fed unpasteurised colostrum were at a significantly greater risk of disease during the milk feeding period, compared to those fed pasteurised colostrum, (because of the higher bacterial levels in unpasteurised colostrum).

A study with Jersey bred calves fed either pasteurised or unpasteurised colostrum also found that calves fed the pasteurised colostrum had higher serum IgG concentrations, higher STP and higher AEA% compared to calves fed unpasteurised colostrum.

A study involving 266 batches of colostrum on 6 US dairy farms, either pasteurised or unpasteurised, found that on average, there was no significant change in IgG content with pasteurisation, but very high-quality colostrum was more negatively affected that poorer quality colostrum. However, the result may be of little practical consequence, as calves fed high quality colostrum, even if pasteurised are likely to have adequate serum IgG levels anyhow.

A Spanish study assessed feeding colostrum and whole milk, either pasteurised or unpasteurised, to dairy calves from birth to 3 weeks. Both colostrum and milk had significantly lower Total Plate Count and Total Colony Count following pasteurisation. Calves fed pasteurised colostrum and milk had significantly lower morbidity and mortality, even though calf serum total protein was not significantly different between the 2 treatments.

Conclusions

• Colostrum can be contaminated in the udder and through every process from when it is extracted to when it is ingested.

• All equipment for handling colostrum should be properly sanitised before use, including the udder.

• Colostrum should ideally be fed fresh, or if stored, refrigerated immediately and used within 48 hours.

• Bacterial contamination of colostrum often reduces the transfer of passive immunity to calves, the impact depends on the level of contamination, the IgG content and the amount/time fed after birth.

• Potassium sorbate can be used to keep colostrum ‘fresh’ up to 4 days when refrigerated, without bacterial spoilage.

• Pasteurisation at 60^0C for a maximum of 1 hour significantly reduces bacterial contamination, often resulting in higher passive immunity in calves, irrespective of the metric used to assess immune status.

• Pasteurisation often improves calf health during the milk feeding period, (reduced morbidity and mortality).

• Pasteurisation should not be viewed as a substitute for good hygiene during the collection, storage and feeding process.

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