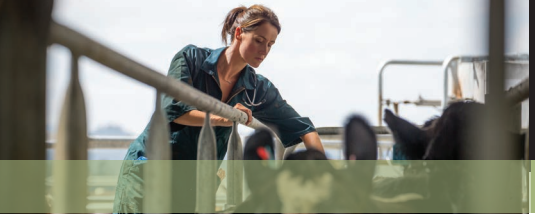

LATEST RESEARCH ON PRESERVING COLOSTRUM - THE EFFECT ON QUALITY AND NUTRITIONAL COMPOSITION

Introduction

Colostrum obtained from dairy cows at the first milking after calving is a high energy feed source for calves. Because there is often a surplus of colostrum on New Zealand dairy farms it is stored in stainless steel vats of varying sizes at ambient temperature, and fed to neonatal calves as required.

Studies have shown that when colostrum is left in a container, drum, or vat, bacterial proliferation occurs[1] and brix level (an indicator of immunoglobulin (Ig) content) decreases[1,2]. Bacterial contamination is potentially harmful to calves for two reasons. Firstly, bacterial pathogens may act directly to cause diseases such as enteritis or septicaemia (e.g. *E.coli* or *Salmonella* spp.[3]), and secondly the presence of bacteria in the small intestine at the time of colostrum ingestion may interfere with systemic absorption of IgG molecules[4,5,6].

Refrigeration, freezing, heat treatment, potassium sorbate and acidification have all been used to preserve colostrum, and all have been shown to reduce or slow the growth and proliferation of bacteria[1,2,7]. Denholm *et al*[2] reported that not using a preservative, or the use of yoghurt as a preservative resulted in a decline in Brix and increased total bacterial counts within 3 days of colostrum storage at ambient temperature, and also that potassium sorbate was superior to these when added as a preservative to fresh colostrum, and was able to maintain the quality during storage. However, the authors only measured coliform and total bacterial counts and did not evaluate any changes in the bacterial species as a result of preservation. Neither did they assess the nutritional value of the colostrum after preservation using the different methods.

The objectives of this study were to investigate the effect of preservation using a yoghurt starter, potassium sorbate and citric acid on counts of aerobic bacteria, *Lactobacillus* sp., *Streptococcus thermophilus* and coliforms, as well as pH, Ig concentration (percent Brix), and protein, fat and anhydrous lactose concentrations of colostrum stored at ambient temperature for 0, 7 and 14 days after collection.

Method

2L of "gold" first milking colostrum was collected from each of ten spring calving herds in the Waikato and sent to Massey University for analysis. 5x 400mL sub-samples were labelled and treated as per Table 1.

Sub-sample	Treatment	Description	Preservation method
1	No preservative added	Day 0 testing	None; not stored
2	No preservative added	Day 7, 14 testing	None (control)
3	Yoghurt preservative	170g of natural yoghurt culture (Easiyo) was mixed with 1L of warm water (30°C) and left at ambient temperature for 24 hours. 5mLs was added to each 400mL colostrum sub-sample.	Yoghurt cultures include *Streptococcus thermophilus, Lactobacillus bulgaricus* and *Lactobacillus acidophilus*. They preserve milk by converting lactose sugars into lactic acid and thus lowering the pH. The lactic acid causes the milk to thicken as it ferments.
4	Potassium sorbate preservative	4 mL of a 50% potassium sorbate solution was added to the 400mL sub-sample.	Potassium sorbate added to water is ionised to sorbic acid, lowering the pH and inhibiting bacterial growth.
5	Citric acid preservative	3g of citric acid powder was added to the 400mL sub-sample.	Lowers the pH, inhibiting bacterial growth.

Table 1. Description of the colostrum sub-samples per farm and their associated treatments

Samples remained in the laboratory at ambient temperature for the duration of the study, and were stirred daily and tested on Days 0, 7 and 14. Tests conducted are presented in Table 2.

Day	Eligible sub-sample ID	Tests
0	1	Counts of total aerobic bacteria, coliforms, *Lactobacillus* sp. and *S. thermophilus* pH, Brix %, Fat %, Protein %, Anhydrous Lactose
7	2, 3, 4, 5	Counts of total aerobic bacteria, coliforms, *Lactobacillus* sp. and *S. thermophilus* pH, Brix %
14	2, 3, 4, 5	Counts of total aerobic bacteria, coliforms, *Lactobacillus* sp. and *S. thermophilus* pH, Brix %, Fat %, Protein %, Anhydrous Lactose

Table 2. Description of tests carried out on each sub-sample on Days 0, 7 and 14

Results

Clustered bootstrap sampling techniques were used for the statistical analysis (hence no p values are reported). For the purposes of this technical bulletin, if the confidence intervals do not overlap, there is a significant difference between treatments for an outcome.

AEROBIC PLATE COUNT (CFU/ML) FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,7,14

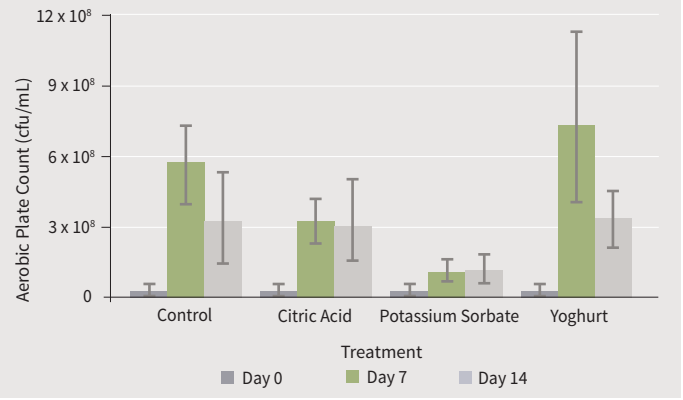

Figure 1.

Preservation with potassium sorbate decreased Aerobic Plate Count (APC) by a factor of 7 compared to Yoghurt at Day 7 and maintained low APC count at Day 14 (Figure 1). There was no difference in APC between yoghurt preservative and control at either Day 7 and 14.

COLIFORM COUNT (CFU/ML) FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,7,14

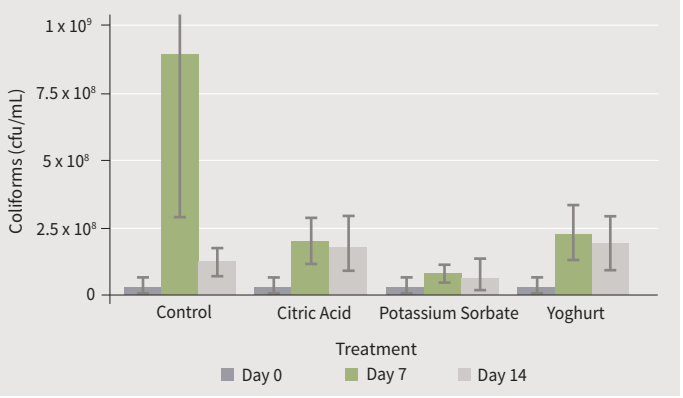

Figure 2.

Coliform count increased 32 times in the control sample between Day 0 and Day 7 (Figure 2). All preservative treatments prevented coliform growth compared to the control sample at Day 7, however by Day 14, there was no difference between the treatments. At Day 7, there were approximately 130-150,000,000 fewer coliform cfu/mL in the potassium sorbate sample compared to yoghurt and citric acid.

***STREPTOCOCCUS THERMOPHILUS* COUNT (CFU/ML) FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,7,14**

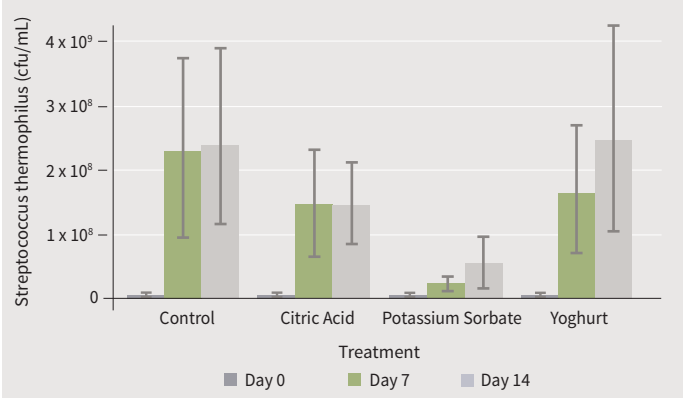

Figure 3.

Potassium sorbate prevented the growth of *S. thermophilus* compared to the other treatments, especially at Day 7, where there was between 7-10 times fewer *S. thermophilus* cfu/mL compared to the other three treatments (Figure 3). There was no difference in the count of *S. thermophilus* in the colostrum preserved by yoghurt or citric acid compared to control.

***LACTOBACILLUS* COUNT (CFU/ML) FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,7,14**

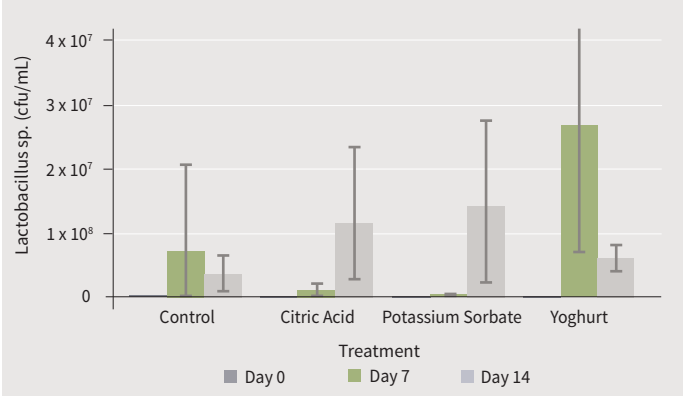

Figure 4.

At Day 7, there were 117 times the number of *Lactobacillus* sp. in the yoghurt-preserved colostrum compared to potassium sorbate-preserved colostrum, but no difference between yoghurt preservative and control (Figure 4). By Day 14, there was no significant difference between any of the groups.

pH FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,7,14

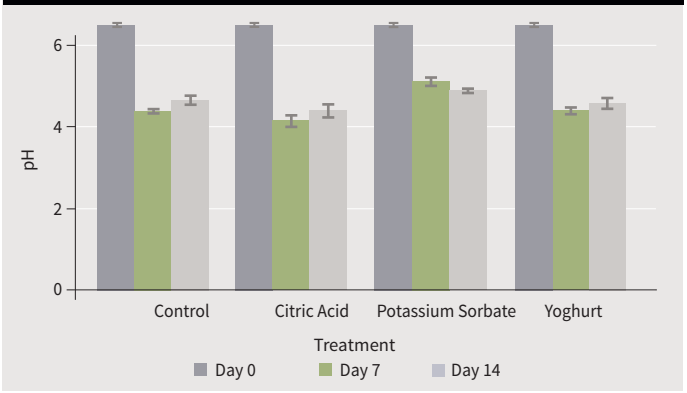

Figure 5.

There was an obvious acidification over time for all four treatment groups, including the control group (Figure 5). The decrease in pH was greater in the potassium sorbate-preserved colostrum group compared to the other 3 groups by approximately 0.5 units at Days 7 and 14.

BRIX % FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,7,14

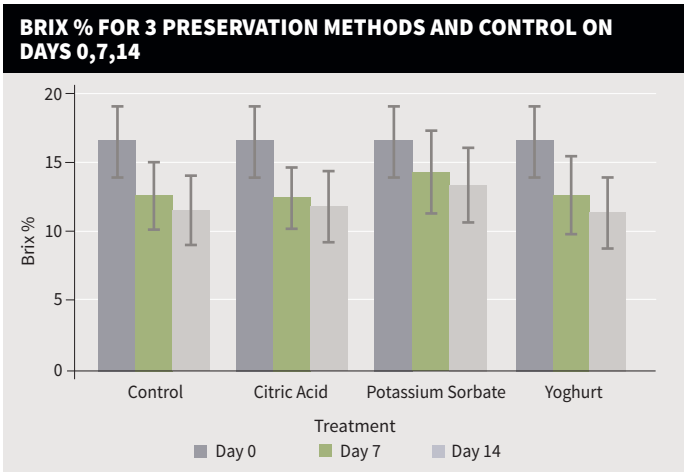

Figure 6.

There was no statistically significant difference over time between the treatments for Brix levels (Figure 6); however, this study was underpowered to find such a difference.

CRUDE PROTEIN % FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0, 14

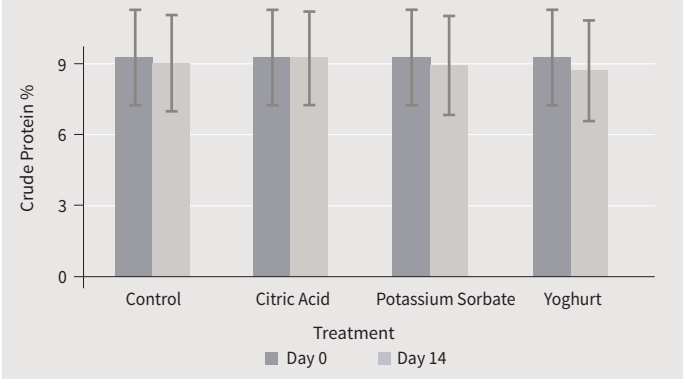

Figure 7.

FAT % FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,14

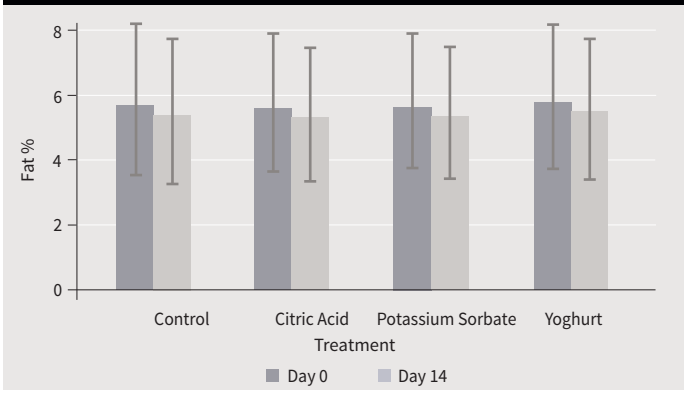

Figure 8.

There was no change in protein % (Figure 7) or fat % (Figure 8) over time regardless of treatment.

LACTOSE (G/100ML) FOR 3 PRESERVATION METHODS AND CONTROL ON DAYS 0,14

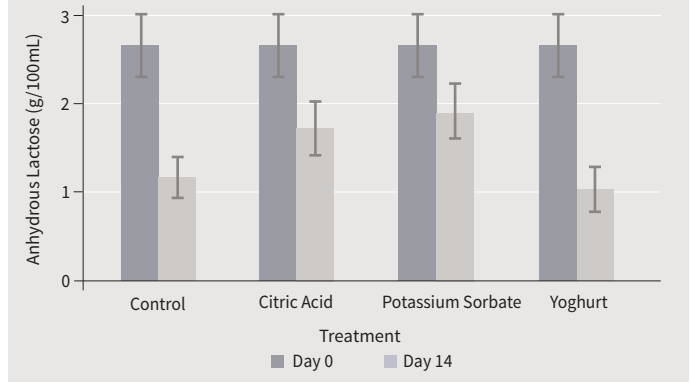

Figure 9.

Anhydrous lactose decreased over 14 days in all samples (Figure 9). The decrease in anhydrous lactose was lower in potassium sorbate-preserved colostrum compared to yoghurt and control samples. During the process of fermentation, bacterial populations such as *Lactobacillus sp.,* and *Streptococcus thermophilus* proliferate using lactose as their energy source converting it to bacterial protein. As expected, there was a greater decrease in lactose for both the control and yogurt groups as greater fermentation occurred in these samples (due to higher bacterial counts).

Conclusions

1) Adopting good hygiene practices is important to reduce the risk of contamination especially with coliform bacteria. Storing colostrum without any preservative increases the potential risk to calves as coliforms proliferate by Day 7.
2) As natural fermentation occurs, *Streptococcus thermophilus* and *Lactobacillus* sp., ("good" bacteria) predominate and there is a natural decline in coliforms ("bad" bacteria). This may explain why many farmers feed unpreserved colostrum to neonatal calves and they grow well and remain disease free.
3) Preservation of colostrum is recommended and all of the preservatives tested in this study were successful at slowing the proliferation of coliforms in colostrum on Day 7 and 14.
   a) Yoghurt preservation of colostrum promotes the fermentation process. This explains why the total bacterial count in yoghurtised milk increased at Day 7 (as lactobacillus growth predominates) and then decreased again at Day 14 as the lactose sugars are exhausted.
   b) Potassium sorbate decreased coliforms the most.
4) Stored colostrum with or without preservative becomes more acidic.
5) The reduction in Brix levels (as an indicator of IgG) on Days 7 and 14 was the same for control and all preservative treatments.
6) The nutritional value of colostrum is maintained over time using all 3 preservation methods.

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