Efficacy of a stabilized liquid potassium sorbate preservative to reduce bacterial proliferation in colostrum or tank milk stored by refrigeration or at room temperature

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Introduction

Though critical to calf health and growth, colostrum and milk represent 1 of the earliest possible sources of exposure of dairy calves to infectious agents, potentially resulting in calfhood illness and/or reduced absorption of colostral antibodies. While FDA-approved preservatives such as potassium sorbate may represent 1 approach to reduce bacterial proliferation in stored colostrum or milk, efficacy studies are relatively limited. Objectives of this study were to describe the effect of a stabilized liquid potassium sorbate preservative product (Dam Fresh™, Solution BioSciences, Inc (SBS), Inc. Morristown, NJ) on 1) bacterial proliferation in bovine colostrum and milk when stored by refrigeration and at room temperature, and 2) immunoglobulin G (IgG) levels in colostrum. We hypothesized that the preservative would reduce bacterial proliferation in stored milk and colostrum while having no negative effect on colostrum IgG levels.

Materials and Methods

Methods were similar for the colostrum and milk studies. Fifteen unique batches of frozen bovine colostrum and tank milk were assembled. After thawing to room temperature and collecting a 15 mL pre-inoculation sample, each batch was inoculated with K99 *Escherichia coli* and *Staphylococcus aureus* (approx. 10^2 to 10^4 cfu/mL). After agitation and collection of a 15 mL post-inoculation sample for culture, the remaining portion of each batch was divided into 2 equal paired aliquots. One aliquot was kept as an untreated control (CON), while the other was treated with Dam-Fresh™ preservative according to the manufacturer's directions (TRT) (colostrum: add 1 oz. into 1 gallon; milk: add 0.5 oz. into 1 gallon). After collecting baseline samples (approx. 5 min) from the TRT and CON samples, the sub-aliquots were each divided into equal portions then assigned to be refrigerated (FR, 39.2°F [4°C]) or stored at room temperature (RT, 68°F [20°C]) for 24 h, 48 h, or 96 h. After completing the assigned treatment, all samples were immediately frozen (-4°F [20°C]) until they could be thawed and cultured. After thawing, routine microbial culture was performed to quantify (cfu/mL) levels of *E. coli, Staph. aureus*, Total Plate Count (TPC), Total Coliform Count (TCC), *Streptococcus* spp, and *Staphylococcus* spp. All bacteria counts were log(base 10) transformed. Colostrum IgG was measured using RID. Data analysis was conducted separately for milk and colostrum, and for samples stored at FR vs RT. Mixed linear regression, controlling for batch as a random effect, was used to investigate the effect of TRT on the growth (i.e. difference) in bacteria counts from baseline (5 minutes) to 24, 48 or 96 h of storage. Final significance was set at P < 0.05.

Results

The geometric mean TPC for pre- and post-inoculated tank milk samples (pre=479; post=69,183 cfu/mL) was significantly lower than for colostrum samples (pre=261,818; post=389,942 cfu/mL). Treatment effects varied by substrate (milk/colostrum), storage conditions (FR/RT), and bacteria group. In FR colostrum, TRT samples had reduced mean (±SE) growth of TPC, TCC, and *Streptococcus* spp after 96 h, and reduced growth of *E. coli* after 48 h of storage (e.g. *E. coli* at 48 h: TRT = -0.001 [0.29], CON = 3.35 [0.29], P < 0.0001). In RT colostrum, TRT samples had reduced growth of TCC, *E. coli*, and *Staph* spp after 96 h, and reduced growth of TPC, *Strep* spp, and *S. aureus* after 24 h (e.g. *E. coli* at 96 h: TRT = 0.21 [0.37], CON = 4.45 [0.37], P < 0.0001). Colostrum IgG was not negatively affected by TRT (24 h IgG in both groups = 79 g/L). In tank milk there was little to no bacterial growth in either TRT or CON samples refrigerated for 96 h, and therefore no beneficial effect of TRT. However in milk stored at RT, TRT resulted in reduced growth of TCC and *E. coli* over 96 h, and reduced growth of TPC over 24 h (e.g. *E. coli* at 96 h: TRT = 2.07 [0.22], CON = 2.76 [0.22], P = 0.006). Unexpectedly, *S. aureus* growth was increased in TRT milk samples stored at RT at 48 and 96 h, though the amount of growth and numerical differences between TRT and CON samples were small.

Significance

In conclusion, the stabilized liquid potassium sorbate preservative product studied can be used to reduce proliferation for several bacteria groups, including TPC, TCC, and *E. coli* in bovine colostrum stored either at RT or FR, and without damaging IgG. While there was no benefit of TRT over 96 h when clean tank milk was properly refrigerated, the preservative did reduce proliferation for some bacteria groups, including TCC and *E. coli*, when tank milk was stored at RT. As such, this preservative may be a useful tool to reduce pathogen exposure to calves through colostrum or milk that is harvested or stored under less than perfect conditions.