

# Effect of Pasteurization Temperature on Immunoglobulin G, Viscosity and Pathogen Viability in Bovine Colostrum

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## Introduction

Calves with failure of passive transfer are much more susceptible to disease and death than calves with adequate colostrum immunoglobulin G (IgG) absorption. Although colostrum is vital to calf health, it can also serve as a vector for pathogens such as *Salmonella* spp, *Listeria monocytogenes*, *Escherichia coli*, *Mycoplasma bovis*, and *Mycobacterium avium* subsp. *paratuberculosis* (MAP), the causative agent of Johne's disease. While batch pasteurization at traditional times and temperatures (145°F [63°C] for 30 minutes) will kill pathogens in colostrum, it destroys significant amounts of IgG. Our objective was to determine if we could use a lower temperature / longer time approach to kill pathogens while still preserving IgG content and activity.

## Materials and Methods

A Rapid Visco Analyzer (RVA) was used to pasteurize 25g samples from 30 unique batches of colostrum at 140 and 145° F (60 and 63°C). Samples from six of these batches of colostrum were also pasteurized at 138, 140, 142, 144 and 145°F (59, 60, 61, 62, and 63°C). The RVA held each sample at 100.4°F (38°C) for 10 minutes, heated it to the target pasteurization temperature over a 30-minute period, held it at the pasteurization temperature for two hours, cooled it to 100.4°F (38°C) over a 30 minute period, and then held it at 100.4°F (38°C) for another 10 minutes. Temperature and viscosity were recorded at 8-second intervals during this procedure. Pre- and post-pasteurization colostrum samples were submitted for analysis of IgG concentration (mg/ml) via a turbidometric-immunoassay (TIA) and for functional analysis of serum neutralizing (S/N) antibodies against bovine viral diarrhea (BVD) virus antigen. Using a commercial batch pasteurizer (DairyTech Inc., Windsor, CO), ten 8-14 gallon batches of colostrum were inoculated with *M. bovis* (4 batches at 108 cfu/ml), *L. monocytogenes*, *E. coli*, and *S. enteritidis* (4 batches at 105-106 cfu/ml) and then pasteurized at 140°F (60°C) for one or two hours. Five batches were pre-pasteurized

for one hour at 140°F (60°C), prior to inoculation with MAP (105-106 cfu/ml) in order to first remove bacterial or fungal contaminants that were interfering with culture of MAP. For each run, samples were collected pre-inoculation, post-inoculation, once the colostrum had reached 140°F (60°C), every 15 minutes thereafter, and once the colostrum had cooled to 100.4°F (38°C). Samples were submitted for IgG testing (both TIA and S/N) and bacterial culture.

## Results

Results for the 30 RVA batches showed that heating colostrum to 140°F (60°C) produced no significant loss in total IgG (- 1.91 mg/ml; P = 0.17) (mean(SD) IgG pre-heating = 76.4(26.5) mg/ml; mean(SD) IgG post-heating = 74.5(24.3) mg/ml). However, increasingly greater losses of IgG occurred if colostrum was heated to 142, 144 and 145°F (61, 62 and 63°C), respectively, with up to a 40% loss of IgG at 145°F (63°C). Viscosity also increased significantly at higher temperatures, and especially at 145°F (63°C). Results for the commercial batch pasteurizer showed that heating large batches of colostrum at 140°F (60°C) for one hour resulted in a numerically small (- 2.45 mg/ml) but statistically significant loss of IgG (P = 0.011) (mean(SD) IgG pre-heating = 64.2(9.4) mg/ml; mean(SD) IgG post-heating = 62.1(9.4) mg/ml). Serum neutralization antibody activity was unaffected (P > 0.05). Viscosity was not visibly increased. After 30 minutes of pasteurization there was no growth detected for *E. coli*, *Listeria*, *M. bovis*, or *Salmonella*. MAP culture results are still pending.

## Significance

Heat-treatment of bovine colostrum at 140°F (60°C) for at least one hour and as long as two hours appears to be a feasible method of killing several different pathogens with very little or no effect on IgG quantity and activity, or colostrum viscosity. Future research is needed to determine if these findings may be successfully replicated under field conditions.