Effect of heat-treatment on nutritional and immune factors in bovine colostrum

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Introduction

Studies have demonstrated that heat-treating colostrum at 140ºF (60°C) for 60 minutes results in a significant reduction in colostral bacteria counts with no overall reduction in colostral IgG concentrations. Preweaned calves fed HT colostrum have enhanced efficiency of absorption of IgG and reduced morbidity. Despite these benefits, limited research exists to describe whether the heat-treatment process harms other colostrum components. The objective of Study 1, described herein, was to describe the effect of heat-treatment on concentrations of several nutrient and immune factors in bovine colostrum. The objective of Study 2 was to describe the effects of heat-treatment on leukocyte viability, alkaline phosphatase (AP) enzyme activity, and IgG concentrations in bovine colostrum.

Materials and Methods

In the first study, 25 unique batches of first-milking bovine colostrum were first sampled as fresh (FR) colostrum, heat-treated at 140ºF (60°C) for 60 minutes with a commercial on-farm batch pasteurizer, and then sampled immediately after as heat-treated (HT) colostrum. Paired FR and HT colostrum samples underwent laboratory testing for levels of dry matter (%), true protein (%), crude fat (%), lactose (%), solids not fat (%), other solids (%), insulin (ng/mL), lactoferrin (mg/mL), IGF (ng/mL), IgG (mg/mL), pH, total plate count (TPC, cfu/mL), total coliform count (TCC, cfu/mL), and somatic cell count (SCC, cells/mL).

In the second study, 22 unique batches of first-milking bovine colostrum were sampled as FR colostrum, heat-treated at 140ºF (60°C) for 60 minutes with a commercial on-farm batch pasteurizer, and then sampled immediately after as HT colostrum. Paired FR and HT colostrum samples underwent laboratory testing for levels of IgG (mg/mL), total WBC count (x 10^6 cells/mL), total viable WBC count (x 10^6 cells/mL), percentage of WBC that were viable (%), TPC (cfu/mL), TCC (cfu/mL), and AP enzyme activity (mU/L).

Results

For the first study, ANOVA revealed that treatment had no effect on any of the measured colostrum components with the exception of TPC and TCC, which were both significantly ($P < 0.0001$) reduced in HT samples (logTPC, 1.2 ± 0.9; logTCC, 0.7 ± 1.0), compared with that in FR samples (logTPC, 4.2 ± 0.8; logTCC, 3.7 ± 1.2). Unexpectedly, SCC, as measured using a NIR assay, was unaffected by treatment, prompting the investigators to complete the second study to investigate whether treatment affected leukocyte viability.

For the second study, ANOVA revealed that treatment had no effect on colostral IgG (FR, 77.8 ± 17.5; HT, 75.2 ± 17.0 mg/mL) but significantly reduced colostral TPC and TCC counts (FR logTPC, 5.2 ± 1.4; HT logTPC, 1.2 ± 1.0; FR logTCC, 4.1 ± 1.8; HT logTCC, 0.3 ± 0.5). The proportion of WBCs that were viable was significantly ($P < 0.0001$) lower in HT colostrum (8.3% ± 2.7%), compared with that in FR colostrum (28.2% ± 11.3%). Chi-square analysis revealed that treatment reduced AP enzyme activity, which was present in 100% and 77% of FR and HT colostrum samples, respectively ($P = 0.02$).

Significance

The implications of this research are that, with the exception of colostral leukocyte viability, veterinarians and producers can be confident that all immune and nutritional parameters tested in these two studies were not negatively affected by heat-treating colostrum at 140ºF (60°C) for 60 minutes. Although not eliminated, the viability of colostral leukocytes was significantly reduced by HT. The function and biological significance of colostral leukocytes in neonatal calves still requires research. However, the reduction in viable leukocytes caused by HT may be less important than the benefits gained, given that a different study (reported separately) has demonstrated that preweaned calves fed HT colostrum suffered less morbidity than did calves fed FR colostrum. Since the HT procedure did not consistently inactivate the AP enzyme in colostrum samples, this test does not hold potential to be used as a monitoring tool for colostrum HT programs on dairy farms.