Feedstuffs Reprint

Pasteurized colostrum results warrant trials

Bottom Line

with
AL KERTZ*

WITH the advent of Johne's control programs, one dimension has been to test cows to determine if they are a carrier. Another is not to feed colostrum from a Johne's-positive cow to other female calves to be reared for herd replacements.

However, this complicates colostrum feeding as not enough may be available to feed calves other than from that dam, and that will not be available if that dam is positive for Johne's.

There are other issues related to clean, quality colostrum. Minnesota workers (Stewart et al., 2005) found that the first control point in feeding clean colostrum is to prevent contamination during the harvest, storage and feeding processes. Prompt refrigeration or freezing along with a preservative agent, such as potassium sorbate, are management strategies to prevent bacterial proliferation.

As herds get larger, they are faced with separate crews for calving and receiving calves for rearing and different shifts around the clock. Thus, there can be problems among shifts operating inconsistently, as well as with crews with differing responsibilities pointing fingers at each other as the source of problems.

Consequently, some dairies have perceived that a major part of the solution to these issues is to pasteurize colostrum, which will take care of Johne's, allow colostrum to be pooled and fed to any/all calves and reduce the bacterial load in colostrum fed.

Two recent Minnesota studies have evaluated key parameters in pasteurizing colostrum. The first (McMartin et al., 2006) used smaller-quantity, laboratory-scale samples.

First-milking colostrum was collected from one commercial dairy farm and frozen at -4˚F for 2-16 weeks. Six unique batches of colostrum were heated in 50 mL aliquots to 138, 140, 142, 144 and 146˚F using a computer-integrated instrument capable of rapidly measuring the apparent viscosity of products over a range of temperatures and mixing conditions.

For each run, this precision instrument was able to hold the sample at 100˚F for 10 minutes, heat it to the target pasteurization temperature over a 30-minute period, hold it at the target temperature for 120 minutes and then cool it to 101˚F (approximate feeding temperature) over a 30-minute period.

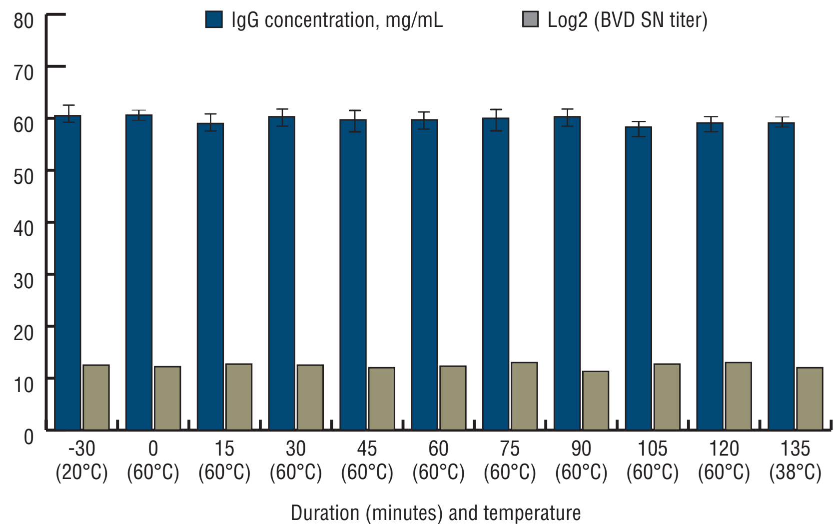
Temperature and viscosity were recorded at eight-second intervals during this procedure. Post heat-treated colostrum samples were frozen at -4˚F.

Data in the Table were fitted to a regression equation and indicated that immunoglobulin G (IgG) concentrations were reduced at 144 or 146˚F, and viscosity was increased at 142, 144 and 146˚F in post-treated samples.

Furthermore, higher-quality colostrum suffered more pronounced losses of IgG and increases in viscosity than moderate-quality colostrum. Additional testing of IgG activity by another assay was limited as congealing of the colostrum in the assay precluded testing of titers for 35% of the samples.

Heating colostrum in this study to the industry standard temperature of 146˚F reduced IgG due to denaturation 34% and increased viscosity 34%.

IgG concentration and antibody titers in colostrum as affected by batch pasteurization



IgG and viscosity after heat treatments of colostrum at five different temperatures

IgG, mg/mL	Pre-heated	Post-heated
138˚F	73.6 ± 15	77.1[a] ± 16
140˚F	71.6 ± 19	70.4[a] ± 16
142˚F	73.0 ± 25	66.1[a] ± 14
144˚F	73.3 ± 20	58.5[b] ± 8
146˚F	76.1 ± 19	43.7[b] ± 25
Viscosity, {$\log_{10}$ (cP)}		
138˚F	1.93 ± 4	1.80[a] ± 7
140˚F	1.88 ± 5	1.85[a] ± 10
142˚F	1.91 ± 6	2.14[b] ± 8
144˚F	1.91 ± 5	2.38[b] ± 9
146˚F	1.86 ± 4	2.65[b] ± 8

Mean ± % coefficient of variation.
[a,b]Different superscripts within a row differ ($P < 0.05$).

© 2006 Feedstuffs. Reprinted with permission from Vol. 78, No. 39, September 18, 2006.

Heating colostrum to 140˚F for two hours did not change IgG concentration or viscosity with the laboratory instrument used in this study.

How a commercial-size batch pasteurizer would fare for IgG and viscosity parameters — and how key important pathogens would be affected — were addressed in a second study (Godden et al., 2006) using a 30-liter commercial-style batch pasteurizer.

The same single-farm source of colostrum was used in this study as in the first study. Thawed colostrum at 68˚F was pooled to create a 30-liter batch, transferred into a commercial on-farm batch pasteurizer and then incubated with four pathogens at the following concentrations: *Mycoplasma bovis* (10^8 cfu/mL), *Listeria monocytogenes* (10^6 cfu/mL), *Escherichia coli* 0157:H7 (10^6 cfu/mL) and *Salmonella enteritidis* (10^6 cfu/mL).

The pasteurization process was the same as in the first study, but target temperature for pasteurization was 140˚F based on results of the first study. Four unique replicates of colostrum were run containing the above pathogens, and samples were taken every 15 minutes during the two-hour pasteurization period. Testing was done at the Veterinary Diagnostic Laboratory at the University of Minnesota.

The same process as for the above four species was then done separately for the Johne's agent, *Mycobacterium avium* subspecies *parartuberculosis* (MAP), with these samples analyzed by the National Animal Disease Center in Ames, Iowa. Samples of colostrum were also analyzed for IgG concentration and activity.

For all four replicate batches: *M. bovis* did not even survive the 30-minute heat-up phase, *E. coli* did not survive the first 15 minutes of the pasteurization phase and *L. monocytogenes* and *S. enteritidis* were not detected after the first 30 minutes of the pasteurization phase.

There is some evidence that living bacteria in colostrum may interfere with passive absorption of colostral antibodies. If so, this would be another benefit of pasteurizing colostrum.

The MAP organism was not detected after 60 minutes of heating at the pasteurization temperature of 140˚F, although these results were less consistent than for the above four pathogens.

Pasteurization at 140˚F (60˚C) did not significantly affect IgG concentration or activity (SN titer), as shown in the Figure.

These data are based on five batches. An additional three batches were also done, but IgG and activity measurements were not available beyond 90 minutes of heating during pasteurization. Two of these three batches were of very high-quality colostrum (> 75 mg/mL). A larger percentage decline in IgG (7.5 versus 2.2%) occurred in these batches (76.6 to 70.8 mg/mL) versus the above five batches.

A similar reduction in SN titers (antibody activity) was not observed in these additional batches. Also, as the authors noted, very high-quality colostrum can afford even a 10% reduction in IgG concentration and still remain very high quality.

Although these results were done with colostrum that was collected, frozen, thawed, inoculated with potential pathogens and then pasteurized, the authors did not expect dissimilar results with fresh colostrum.

The Bottom Line

First, it must be recognized that these results were achieved under controlled laboratory conditions. Other bioactive factors found in colostrum (Kertz, 2002) may possibly be affected negatively.

However, before these positive results from pasteurizing colostrum are largely implemented, large-scale controlled field studies should be done to determine how these results may best be implemented, what calf benefits in short- or long-term health and growth and reduced transmission of MAP may result and what economic benefits may accrue.

References

Godden, S., S. McMartin, J. Fertag, J. Stabel, R. Bey, S. Goyal, L. Metzger, J. Fetrow, S. Wells and H. Chester-Jones. 2006. Heat-treatment of bovine colostrum. II: Effects of heating duration on pathogen viability and immunoglobulin G. J. Dairy Sci. 89:3476-3483.

Kertz, A.F. 2002. Feeding colostrum beyond first day may have growth benefits. Feedstuffs, Sept. 9, p. 10-11.

McMartin, S., S. Godden, L. Metzger, J. Fertag, R. Bey, J. Stabel, S. Goyal, J. Fetrow, S. Wells and H. Chester-Jones. 2006. Heat treatment of bovine colostrum. I: Effects of temperature on viscosity and immunoglobulin G level. J. Dairy Sci. 89:2110-2118.

Stewart, S., S. Godden, R. Bey, P. Rapnicki, J. Fetrow, R. Farnsworth, M. Scanlon, Y. Arnold, L. Clow, K. Mueller and C. Ferrouillet. 2005. Preventing bacterial contamination and proliferation during the harvest, storage and feeding of fresh bovine colostrum. J. Dairy Sci. 88:2572-2578.

*Dr. Al Kertz is a board-certified, independent dairy nutrition consultant based out of St. Louis, Mo. His area of specialty is dairy calf and heifer nutrition and management. To expedite answers to questions concerning this article, please direct inquiries to *Feedstuffs*, Bottom Line of Nutrition, 12400 Whitewater Dr., Suite 160, Minnetonka, Minn. 55343, or e-mail comments@feedstuffs.com.