Feedstuffs. Reprint

Heating times, colostrum quality affect calf's absorption of IgG

Bottom Line

with
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PREVIOUSLY, I reviewed two key University of Minnesota studies (Godden et al., 2006; McMartin et al., 2006) on heat treatment of colostrum (*Feedstuffs*, March 8, 2010).

These studies established that heating colostrum to 140°F (60°C) for 60 minutes was the best scenario to reduce bacterial counts while limiting damage to immunoglobulin G (IgG) activity and levels.

A new study by Saldana et al. (2019) looked at several factors building on those and other studies. In particular, this study was done to determine the effects of no heating or two different heating temperatures with three levels of colostrum quality on passive transfer of immunity in dairy calves.

First-milking colostrum was taken from both first-calf and older cows in the Pennsylvania State University dairy research herd. After colostrum was initially frozen individually, it was later thawed, pooled and then sorted into three quality categories — low, medium and high — as indicated by use of a colostrometer.

Samples of these three quality colostrums were taken and measured for standard plate count, coliform count, noncoliform Gram-negative, environmental streptococci, contagious streptococci and coagulase-negative staphylococci. Samples were also submitted to a commercial laboratory for analysis of fat (ether extract/Mojonner method), total protein (Kjeldahl method) and total solids. Further assays were done at Penn State for ash, phosphorus, potassium, magnesium, iron, sodium, sulfur, copper, zinc and manganese.

Holstein calves (54 females and 54 females) were separated from their dams within 20 minutes of birth and assigned to one of three heat treatments and three colostrum quality treatments in in a 3 x 3 factorial design. Colostrum was provided to each calf by esophageal feeder within two hours of birth and in a single four-quart tubing. Blood samples were taken before calves were fed colostrum and 24 hours after birth for serum protein analyses, and the serum IgG concentration was determined by enzyme-linked immunosorbent assay.

Apparent efficiency of absorption (AEA) of IgG was calculated as AEA = [(birth weight x 0.095 x serum IgG)/total IgG fed] x 100. Hematocrit was included as a covariate for analysis of serum IgG concentration, total serum protein (TSP) and AEA.

Extensive tabular data are presented in the paper for the composition of colostrum content before and after treatment. Interestingly, the low-quality colostrum in this study had 11.6% total protein, 21.3% solids and 52.3 mg/mL of IgG — all indicators of the typical cutoff for characterizing colostrum as acceptable quality. Medium- and high-quality colostrum had 65.7 and 98.1 mg/mL of IgG, respectively.

Decreases in IgG concentration before and after heat treatment were: 6.1 mg (6.2%), 10.5 mg (10.7%), 8.1 mg (12.3%), 10.8 mg (16.4%) and 6.3 mg/mL (12%) for 30- and 60-minute heat-treated high-quality colostrum, 30- and 60-minute heat-treated medium-quality colostrum and 30- and 60-minute heat-treated low-quality colostrum, respectively (Table). These differences were significantly different among quality and heat treatments.

The various bacterial categories did not differ before and after treatment for colostrum quality but were different among heat treatments. There were no significant differences at birth among treatment categories for birth weight, age at colostrum feeding, TSP, IgG and hematocrit.

Generally, colostrum quality increased TSP, especially for high versus medium and low quality within heating times. The same was true for IgG and AEA and additionally for heat treatment too. However, there were no differences for hematocrit.

These results were similar to other studies, including some done by the same Penn State group.

Successful passive transfer of IgG is considered to be greater than 10 mg/mL, although some will say that it should be greater than 15 mg/mL. In the latter case, only calves on medium-quality colostrum heated for 30 minutes would not meet that level. Of the nine calves that had failure of passive transfer of antibodies, seven received low-quality colostrum treated for 30 minutes, and two calves received low-quality unheated colostrum.

The greatest IgG levels were for the 60-minute treatment, but notice that AEA actually declined within each heat treatment as colostrum quality went from medium to high quality. Why might this be? As the authors discussed, and as other studies have noted as well, high-IgG colostrum may exceed the capacity of receptors carrying IgG from the intestine wall into the bloodstream. This is most likely to occur when calves are fed medium- to high-quality colostrum heated for 60 minutes.

The other element in this picture is that colostrum with a lower bacterial count has a higher absorption efficiency of IgG. There is some debate as to whether bacteria compete with IgG for receptors and if that is why this occurs or if it is something else. Whatever the reason, lowering the bacterial count does increase IgG absorption from colostrum.

The Bottom Line

Feeding higher-quality colostrum in combination with lowering the amount of bacteria by heating colostrum at 140°F for 60 minutes was the best combination to maximize IgG blood levels in calves.

However, implementation of this practice requires an appropriate protocol for quality control. This requires sampling and a bacteria assay to determine how effective and consistent that heating temperature is and monitoring the time and temperature of the batch pasteurizer being used.

The last step is to cool colostrum quickly and feed it as soon as it cools to calf body temperature. Colostrum should be refrigerated if not fed within

Composition of colostrum content

	-------Unheated-------			--Heated for 30 min.--			--Heated for 60 min.--		
	Low	Medium	High	Low	Medium	High	Low	Medium	High
TSP, mg/mL	5.3	5.6	6.1	5.3	5.6	6.3	5.2	5.7	6.1
IgG, mg/mL	19.4	18.2	21.4	13.3	22.1	25.7	21.6	26.3	27.2
AEA, %	37.3	26.2	20.8	32.6	39.6	25.4	47.3	48.5	28.9
Hematocrit, %	28.5	30.3	32.2	31.5	31.8	27.0	31.4	31.2	31.2

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two hours of heat treatment or frozen if not used within three days (Godden, 2007).

References

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