# Comparison of Two Methods for Thawing Colostrum Before Supplemental Feeding to Newborn Calves

**D.P. Olson,** *D.V.M., M.S., Ph.D.*
*Department of Veterinary Science*
*University of Idaho*
*Moscow, Idaho 83843*



**Summary**

The present study was designed to compare two methods of thawing and warming frozen colostrum from cows. Pooled colostrum was divided into one quart aliquots and frozen (–20°F). The frozen colostrum was thawed and warmed, two quarts at a time, to 104°F either by immersion in a stainless steel pail containing boiling water or in a microwave oven set at a power level of 60%. Two quart aliquots of thawed and warmed colostrum were fed to newborn calves by two hours after birth and at eight hours of age.

The time required to thaw and warm the colostrum by immersion in boiling water was approximately 20 minutes while the time required for treatment in a microwave oven was approximately 45 minutes. The concentration of immunoglobulin (Ig) G2 ($IgG_2$) was significantly lower ($P \leq 0.05$) in colostrum thawed and warmed in boiling water when compared to $IgG_2$ concentrations in colostrum treated in a microwave oven. There were no significant treatment differences in concentrations of IgM, $IgG_1$ or IgA in the thawed and warmed colostrum.

The $IgG_1$ and $IgG_2$ concentrations in the sera of calves at 24 hours of age fed colostrum treated in boiling water were nearly significantly lower than ($P=0.06$) the respective Ig concentrations in calves fed colostrum treated in a microwave oven.

**Introduction**

Most calves are born hypogammaglobulinemic[2] or agammaglobulinemic[5] and must rely on suckling soon after birth to obtain protective levels of passively acquired colostral immunoglobulins (Igs). Calves are able to absorb colostral Igs from the intestinal tract into their bloodstream until 24 to 36 hours of age[1]. After this time, gut closure occurs and milk-derived Igs only provide passive protection against pathogenic microorganisms within the intestinal lumen.

Calves may not develop peak serum levels of passively acquired Igs before 24 hours of age. Those calves that fail to attain a normal passive immune status at an early age are often more susceptible to diseases caused by pathogenic microorganisms. Factors often listed as responsible for failure of passive transfer of colostral Igs into calves include 1) failure of calves to suckle, 2) delayed time of first suckling, 3) insufficient quantity of colostrum available from the dam, 4) temporary inability to absorb ingested colostrum because of hypothermia, and 5) ingestion of inferior quality colostrum. When suspected, failure of passive transfer in a calf can be diagnosed either by observing the cause(s) listed or by quantifying the total Ig concentration in serum. Procedures such as the sodium sulfite or zinc sulfate turbidity tests or the single radial immunodiffusion test provide a rapid and inexpensive estimate of the passive immune status of calves. Hypogammaglobulinemia exists in calves when the total Ig concentration in their sera is < the range of 5.0 to 10.0 mg/ml (Drs. S. Wikse, College Station, Texas and O.M. Radostits, Saskatoon, Saskatchewan, Canada, personal communications).

Calves, diagnosed as hypogammaglobulinemic and less than 24 hours of age, should be fed up to one gallon of supplemental, superior quality colostrum that contains a concentration of total Igs > 50.0 mg/ml. This supplemental colostrum can be given to calves either from a nipple bottle or with anesophageal feeding tube and bag. Some producers collect and pool superior quality colostrum from selected cows at parturition and preserve this material by refrigeration or freezing until needed. The pooled colostrum must be warmed to body temperature (approximately 100°F) before it is given to calves. Depending on the method used, problems, such as prolonged time required for thawing and warming and excessive denaturation of Igs and nutrients due to pyrolysis, may result when preparing frozen colostrum for use.

The objective of the present study was to compare two practical methods for thawing and warming frozen colostrum from cows. Specific comparisons were made of 1) the times required by each method to thaw and warm frozen colostrum to body temperature, 2) the affects each thawing and warming method had on Ig concentrations in the colostrum and 3) the affects of each thawing and warming method on colostral-derived Ig concentrations in

calf serum after the material was fed to newborn animals.

## Materials and Methods

*Collection of Colostrum*

Colostrum was obtained from adult Holstein-Friesian cows at parturition. One quart aliquots of the pooled colostrum were placed into heavy-duty plastic freezer bags and frozen (–20F).

*Colostrym Thawing and Warming Procedures*

Frozen colostrum was thawed and warmed, two quarts at a time, to 104°F by immersion in a stainless steel pail (4 gallon capacity) of boiling water (approximately 3½ gallons) or by use of a microwave oven (General Electric Corp.; 625 Watts, 1.3 cubic feet). The power level on the microwave oven was set at 60%. The colostrum was mixed by agitating the bags every five minutes in the boiling water or in the microwave oven to assure even thawing and warming. After thawing and warming, the colostrum was filtered through a wire mesh strainer (household variety) to remove small clumps of coagulated material.

*Animals and Sample Collection*

Thirteen, presuckled, newborn Holstein-Friesian calves were each fed four quarts of thawed and warmed colostrum from nipple bottles. Two quarts of colostrum were given by two hours after birth and two quarts were given at eight hours of age. Seven calves were fed colostrum that had been thawed and warmed in boiling water and six animals were fed colostrum that had been thawed and warmed in a microwave oven. The animals were bled by jugular venipuncture before their first feeding and at 24 and 48 hours of age. Whole blood samples were allowed to coagulate and sera were stored (–20F) until analyzed.

*Laboratory Procedures and Statistical Analysis*

The single radial immunodiffusion method of analysis[3,4] was used to quantify the concentrations of IgM, $IgG_1$, $IgG_2$, and IgA in samples of thawed and warmed colostrum and in calf sera. Linear regression analysis was used to determine the Ig concentrations in the samples tested. Least squares means ± sum of the respective Ig concentrations were computed. A general linear model statistical analysis program was run on the obtained data to determine the main treatment effects.

## Results and Discussion

Hypogammaglobulinemic calves, less than 24 hours of age, should be fed supplemental, superior quality colostrum as soon as possible to assure maximal absorption before gut closure. The methods used to thaw and warm colostrum were chosen for the present study because they involved appliances and utensils that are convenient to use and are commonly available in most households. Although other methods, such as use of an electric space heater or a kitchen oven, could be used for thawing and warming colostrum, these methods were judged as too time consuming or impractical.

During preliminary trials, aliquots of colostrum were thawed and warmed at different power level settings of the microwave oven. Power level settings greater than 60% resulted in coagulation of the material. In other preliminary trials, aliquots of colostrum were thawed and warmed by both methods but without mixing. Failure to mix the colostrum during thawing and warming by either method also resulted in coagulation of the material. The coagulated colostrum appeared to be denatured and could not be fed to calves because it would not flow through either a nipple bottle or an esophageal tube feeder.

*Time Required to Thaw and Warm Colostrum*

The average time required to thaw and warm two quarts of colostrum to 104°F in boiling water was approximately 20 minutes while the time required to thaw and warm an equal volume of colostrum in a microwave oven was approximately 45 minutes.

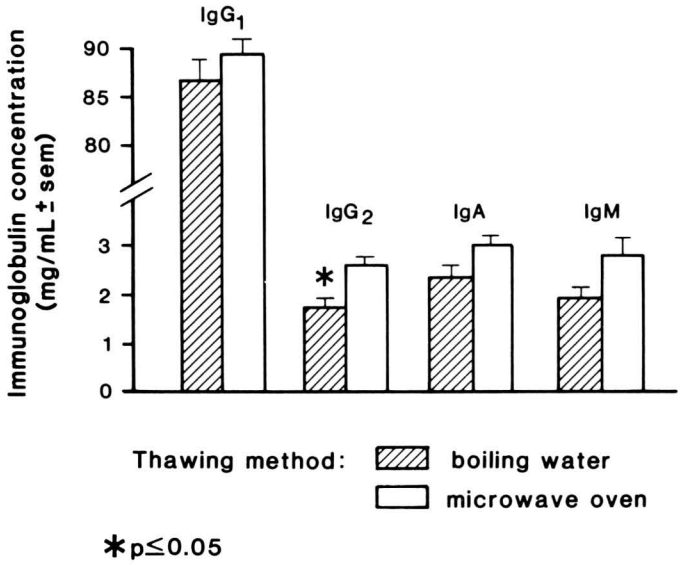
*Immunoglobulin Concentrations in Thawed and Warmed Colostrum*

The concentrations of the Igs in thawed and warmed colostrum fed to calves soon after birth and at eight hours of age are summarized (Figs. 1 and 2, respectively). There was a significant decrease ($P \leq 0.05$) in the concentration of $IgG_2$ in colostrum that was treated by immersion in boiling water when compared to the corresponding $IgG_2$ values obtained by treatment in a microwave oven. The concentrations of the other Igs in colostrum thawed and warmed in boiling water were consistently lower than the corresponding values for colostrum treated in a microwave oven although the differences were not significant. These results did not, however, indicate whether either treatment method degraded the Igs and made them less available or unavailable for absorption from the intestinal tract of calves. Accordingly, it was necessary to test whether calves were able to absorb the Igs colostrum treated by either thawing and warming method.

*Immunoglobulin Concentrations in the Sera of Calves Fed Thawed and Warmed Colostrum*

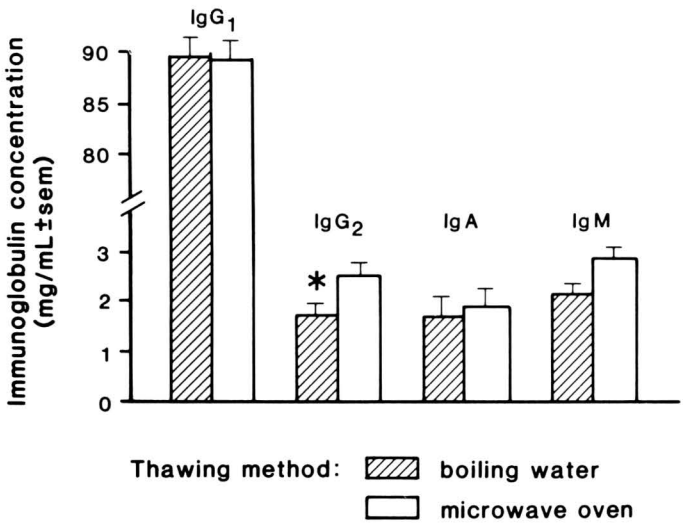
All calves were agammaglobulinemic when their sera were tested before the first feeding of thawed and warmed colostrum. The concentrations of the Igs in the sera of these calves tested at 24 and 48 hours of age are summarized (Figs. 3 and 4, respectively). The $IgG_1$ and $IgG_2$ concentrations in the sera of calves at 24 hours of age fed colostrum treated in boiling water were nearly

Figure 1. Immunoglobulin concentrations in thawed colostrum fed to newborn calves



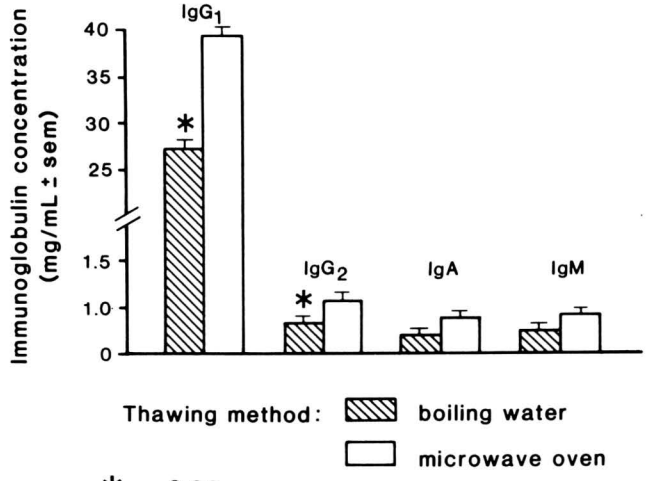

*p≤0.05

Figure 2. Immunoglobulin concentrations in thawed colostrum fed to calves at 8 hours of age



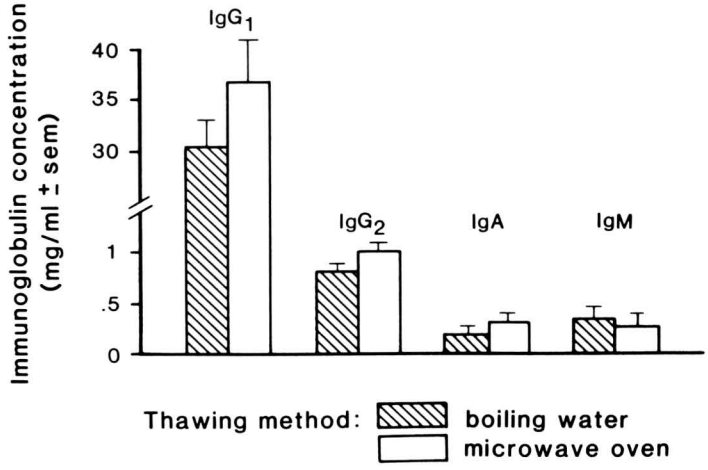

*p≤0.03

Figure 3. Immunoglobulin concentrations in serum of calves fed thawed colostrum and tested at 24 hours of age




*p = 0.06

Figure 4. Immunoglobulin concentrations in serum of calves fed thawed colostrum and tested at 48 hours of age




significantly lower than (P = 0.06) the respective Ig concentrations in calves fed colostrum treated in a microwave oven. The concentrations of IgM and IgA in sera of calves fed colostrum thawed and warmed in boiling water or in a microwave oven were not significantly different (P>0.05).

Immunoglobulins of the IgG class in cattle are believed to be most important in providing high levels of passive humoral protection for suckled neonates, in part because they are normally present in highest concentrations in colostrum. Results of the present study indicate that the boiling water method of treatment lowered the concentrations of $IgG_1$ and $IgG_2$ in colostrum and that there were correspondingly lower concentrations of these Igs in the sera of the calves fed this material. Treatment of colostrum in boiling water may also have produced physicochemical alterations of the IgG molecules so that calves were not able to absorb them as well as those from microwave oven-treated material. In either case, it is probable that significant treatment differences in serum IgG concentrations would have been found if more calves had been tested.

At first glance, the results reported here suggest that use of a microwave oven set at a power level of 60% is the preferred method for processing frozen colostrum when compared to immersion of this material in boiling water. Although the boiling water method required less than

one-half the time to thaw and warm colostrum when compared to a microwave oven, the results of the Ig data tend to favor the microwave oven method of treatment. However, accounting for the limited scope of the present study, more detailed information is required. For example, studies are needed to determine the practicality of thawing and warming colostrum in several changes of water set at a temperature(s) less than boiling. Although processing frozen colostrum in this manner would increase the effort in handling and prolong the time required for thawing and warming, this method would be less likely to lower the total Ig concentration and could remain as a practical treatment option. Similarly, studies are needed to determine the effectiveness of other sizes and brands of commercially available microwave ovens, set at different power levels, in processing frozen colostrum.

## Summary

The present study compared two practical methods for thawing and warming frozen colostrum. With either method, however, care must be taken to avoid denaturation of the material because of uneven and excessive heating. Based on the data for passive transfer of colostral Igs to the calves, the results suggest that use of a microwave oven is an acceptable method for thawing and warming frozen colostrum.

## Acknowledgements

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