J. Dairy Sci. 99:8981–8990
http://dx.doi.org/10.3168/jds.2016-11200

Survey of bovine colostrum quality and hygiene on northern Victorian dairy farms

A. J. Phipps,*[1] D. S. Beggs,† A. J. Murray,* P. D. Mansell,† M. A. Stevenson,† and M. F. Pyman†
*Rochester Veterinary Practice, 72 Lowry Street, Rochester, 3651, Australia
†Faculty of Veterinary and Agricultural Sciences, University of Melbourne, Werribee, 3030, Australia

ABSTRACT

One of the major challenges for dairy producers is to produce, harvest, and store high-quality colostrum and feed it to their replacement heifer calves. Limited published data are available in Australia regarding the relationship between colostrum management, hygiene, and quality. The objectives of this study were to investigate (1) the colostrum storage and handling practices carried out on farm; (2) the immunoglobulin concentration and bacterial composition of colostrum being fed to replacement dairy heifer calves; (3) the percentage of colostrum being fed to replacement dairy heifer calves that meet industry recommendations; and (4) risk factors for bacterial contamination of colostrum. The study was carried out on 24 dairy farms located near Rochester, Victoria, Australia. Two hundred forty colostrum samples were collected (10 samples per farm). Each farm harvested and stored first-milking colostrum under normal farm conditions. A 10-mL sample of the colostrum was collected in a sterile container immediately before feeding, and a Brix refractometer reading was taken. The samples were then frozen at −4°C and submitted for bacterial concentration analysis. Fifty-eight percent of colostrum samples met the recommended industry standard of a total plate count (TPC) of <100,000 cfu/mL, and 94% of colostrum samples met the recommended industry standard of total coliform count (TCC) of 10,000 cfu/mL. However, when all the current industry recommendations for TPC, TCC, and Brix refractometer percentage for colostrum quality were considered, only 23% of the samples met all standards. These findings demonstrate that a large number of calves were at risk of receiving colostrum of poor quality, with high bacterial loads that may have interfered with the acquisition of transfer of passive immunity and affected calf health. Further investigation is required to identify the farm-specific factors that may influence the level of bacterial contamination of colostrum. Recommendations as a result of this study include refrigeration of excess colostrum shortly (within 1 h) after collection and thorough disinfection of the calf feeding apparatus before use.
Key words: colostrum management, dairy calf, total plate count, coliform

INTRODUCTION

The management and feeding of high-quality colostrum is important for the acquisition of transfer of passive immunity (**TPI**) and has been well investigated. Successful TPI has short-term effects for reducing the risk for morbidity and mortality in the preweaning period and long-term positive effects on calf health and future production (Bush and Staley, 1980; DeNise et al., 1989; Wells et al., 1996; Robison et al., 1988; Donovan et al., 1998; Quigley and Drewry, 1998; Faber et al., 2005).

The timing of feeding colostrum relative to birth and the colostral IgG concentration are widely considered the factors that have the greatest influence on the TPI and calf health (Arthington et al., 2000). Bacteria in colostrum that are derived either by shedding from the mammary gland or from environmental contamination are believed to either bind free IgG in the intestinal lumen or block the uptake and thus transport of IgG into the enterocyte (James et al., 1977, 1981; James and Polan, 1978; Staley and Bush, 1985). Bacteria in the colostrum could affect the immunoglobulins available for transport into the calf's enterocytes, possibly interfering with the TPI (Elizondo-Salazar and Heinrichs, 2009). Few field studies have quantified the effect of feeding colostrum with high bacterial counts and the association with immunoglobulin absorption in calves. Two recent studies have reported a deleterious association between bacteria counts in colostrum and immunoglobulin absorption (Poulsen et al., 2002; Johnson et al., 2007).

Stewart et al. (2005) identified control points for bacterial contamination of colostrum from harvest-

Received March 22, 2016.
Accepted July 27, 2016.
[1]Corresponding author: ashphipps87@gmail.com

ing to feeding of colostrum to calves. They found the harvesting process to be a significant control point for contamination of colostrum. Bacteria may be introduced into the colostrum from the teat skin, milking cup liners, hoses, or buckets.

A wide search of the current available literature revealed very limited data regarding the percentage of colostrum being fed to replacement dairy calves on Australian dairy farms that meets the industry recommendations on quality and hygiene. The objectives of this study were to investigate (1) colostrum storage and handling practices carried out on farm; (2) the immunoglobulin concentration of colostrum being fed to replacement dairy heifer calves; (3) the bacterial composition of colostrum being fed to replacement dairy heifer calves; (4) the percentage of colostrum being fed to replacement dairy heifer calves that meets industry recommendations for both immunoglobulin concentration and bacterial composition; and (5) risk factors for bacterial contamination of colostrum.

MATERIALS AND METHODS

Study Population

The source population for this study comprised commercial dairy herds in the Rochester district of Victoria, Australia. The eligible population was herds whose herd managers used the services of the Rochester Veterinary Practice and routinely supplemented replacement heifers with colostrum once they had been brought into their calf rearing facilities. In May and June 2014, herd managers from eligible herds were invited to take part in the study. The study population comprised the herds whose herd managers had agreed to undertake the colostrum sampling protocols defined as part of the study design. Fresh colostrum samples were collected from 24 dairy herds that calved down a proportion of their cows between July 15 and August 31, 2014.

Sample Collection and Storage Process

The study start date was the planned start of calving date for spring-calving cows in each study herd. During the first visit to a study farm, a short questionnaire on general practices was completed with the herd manager or employees responsible for feeding colostrum to replacement heifer calves.

On each farm, colostrum was harvested according to normal farm practices and stored at either ambient temperature, refrigerated, or frozen for a period of time before being fed to a calf or calves. A 10-mL sample of colostrum was collected by the investigator into a sterile container at the time the colostrum was offered to a calf or calves directly from the feeding apparatus used to feed the calf or calves colostrum. A Brix refractometer reading was taken at the time of sampling from each of the samples, using a commercially available Brix refractometer (Brix TE-RM32B with Automatic Temperature Compensation from 10°C to 30°C, Brix range 0–32%, Test-Equip Pty Ltd., Dandenong South, Victoria, Australia). Further information specific to the individual sample was collected at the time of sampling including the source (dam, another herd mate, or pooled); storage method (ambient temperature, refrigeration, or freezing); container used to store the colostrum (plastic, metal, other, and lid or no lid); duration of storage; feeding apparatus cleaning or disinfection practices; and the handling of the colostrum before sampling.

The colostrum samples were immediately frozen at −4°C. This process was repeated for 10 samples on each of the 24 study farms during the 4-wk period following planned start of calving date.

Colostrum Evaluation Process

All frozen colostrum samples were submitted in batches to a local laboratory (Gribbles Veterinary Pathology, Melbourne, Victoria, Australia) where the total plate count (**TPC**) and the total coliform count (**TCC**) for each sample was determined. The TPC results were reported as the number of colony-forming units per milliliter (cfu/mL) and categorized as no growth, <10,000 cfu/mL, 10,000 to 100,000 cfu/mL, and >100,000 cfu/mL. The TCC results were reported as the number of cfu per milliliter and categorized as no growth, <1000 cfu/mL, 1,000 to 10,000 cfu/mL, and >10,000 cfu/mL.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics 2013 for Windows, Version 22.0 (IBM Corp. Armonk, NY). Descriptive statistics were carried out to document the number of herd managers giving a response for each of the questions with ordinal or nominal outcomes. For continuous variables, the mean, standard deviation, and minimum and maximum values were calculated.

Responses to questions in the questionnaire were either binary (e.g., yes or no) or continuous [e.g., volume (L) of colostrum fed to calves]. Herd size, defined as the number of cows in the milking herd midway through the milking season, was categorized into <300 cows and ≥300 cows.

A binary logistic regression model was developed to identify characteristics of colostrum harvesting, stor-