Monitoring the Quality of Colostrum and Pasteurized Waste Milk

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Abstract

Raising healthy calves depends upon successful management of a number of environmental and nutritional factors. Calves are particularly susceptible to enteric diseases when their diet is contaminated with high levels of bacteria. Veterinary technicians can play a key role in helping dairies minimize diseases caused by enteric pathogens by trouble-shooting and proactively monitoring the bacterial load in colostrum and milk offered to the calves. This paper describes the methods for quantitative and serial culturing, and gives current bacterial guidelines for colostrum and pasteurized waste milk.

Résumé

L'élevage de veaux en santé dépend de la bonne gestion d'un ensemble de facteurs environnementaux et nutritionnels. Les veaux sont particulièrement susceptibles aux maladies entériques lorsque leur ration est contaminée par un grand nombre de bactéries. Les techniciens vétérinaires peuvent jouer un rôle clef pour minimiser les maladies causées par les pathogènes entériques dans les fermes laitières en diagnostiquant des problèmes et en surveillant proactivement la charge bactérienne dans le colostrum et le lait donnés aux veaux. Cette article décrit les méthodes de culture quantitative et en série et propose des directives à jour de régie des bactéries dans le colostrum et le lait de rejet pasteurisé.

Colostrum Management: Monitoring Bacterial Load

Proper colostrum management is one of the most important factors in determining a calf's health and survival. Calves not only require a sufficient volume within the first few hours of life, but the colostrum needs to be clean and of high quality. Monitoring colostrum for adequate levels of immunoglobulins (IGs) has been described elsewhere[2,7,8] and will not be covered in this presentation, which will focus instead on cleanliness, i.e. monitoring bacterial loads.

High bacterial loads can cause diarrhea and septicemia in calves and can also block absorption of the critical IG proteins, which in turn could lead to failure of passive transfer.[2] The magnitude of bacterial contamination, particularly coliforms, affects the severity of clinical disease seen in the calves (Table 1).

Two methods to monitor the quality of colostrum in terms of bacterial load are quantitative and serial colostrum cultures. Quantitative cultures start with plating a standard amount of milk (in microliters). The number and types of colonies are multiplied by the corresponding dilution factor so that the number of colony forming units/mL can be determined (cfu/mL). Ten and 50 microliters are plated on two blood agar plates, and 10 and 100 microliters are plated on two MacConkey plates. After incubation overnight, the colonies are counted and characterized. To determine the final count, multiply the amount plated by the factor that yields a final count of 1000 (10 microliters x 100 = 1000, 50 microliters x 20 = 1000), then multiply that number by the number of colonies on the plate. This will give you cfu/mL. For example, if a total of 25 colonies are on the 10-microliter plate, the final count is 2500 cfu/mL (100 x 25). When deciding which plate to count (10-microliter vs 50-microliter), choose the plate with the colony counts between 50 and 100 total bacteria. Plates with colonies more than 100 are inaccurate to count. If both plates have over 100 colonies, proceed with further dilutions.

Serial colostrum cultures are quantitative cultures plated from samples taken during each of the multiple steps in the process from harvesting the colostrum to feeding the calf. Producers collect composite milk samples from the cow's udder, the stainless steel bucket used to harvest the milk, and any containers into which the milk is transferred after that step, such as milk jugs or 5-gallon buckets. Finally, a sample is collected from the nipple or bucket that is used to feed the calf. Ideally, these samples would be the same colostrum, from the beginning (the cow) to the end (the calf). Look for increases across the samples to determine if there is a problem with detecting mastitis in cows or poor sanitation of teats prior to harvesting colostrum, sanitation of the milking bucket, incubation of bacteria in buckets before cooling, or sanitation of calf-feeding equipment.

Once establishing that the procedure is adequate and a protocol is developed or modified and is being followed, colostrum quality can be monitored on a regular basis by just "spot checking" the final product, i.e. quantitatively plating the colostrum that comes from the nipple or bucket. Whenever the numbers exceed the recommended goals (Table 2), serial colostrum sampling

Table 1. Expected clinical outcome in calf health given various levels of coliforms in colostrum, based upon field observations.

Coliform counts in colostrum	Expected clinical outcome
<5,000 cfu/mL	Minor scours in less than one-third of calves
5,000-20,000 cfu/mL	Moderate scours in up to three-fourths of calves, lasting 7-10 days (rather than 2-4 days)
21,000-50,000 cfu/mL	Occasional death at 3-5 days Severe scours between seven and 21 days in nearly all the calves
51,000-250.000 cfu/mL	Very severe scours Enterotoxemia starting to cause rapid onset death Bloated calves at 2-6 days Persistent scours up to three weeks of age, affecting nearly all calves Respiratory illness as secondary infection common
>250,000 cfu/mL	Frequent mortality associated with enterotoxemia Most calves require antibiotics and IV or SubQ fluids

Adapted from Leadley S: Colostrum: coliform bacteria standards for calf health, 2010, http://www.atticacows.com/documentView.asp?docID=1486

Table 2. Bacterial goals for colostrum.

Colostrum goals	
Fecal coliforms (*Escherichia coli*, *Klebsiella*)	<10,000 cfu/mL
Gram-negative bacillus (other gram-negative)	<50,000 cfu/mL
Streptococcus (non-ag)	<50,000 cfu/mL
Staphylococcus species	<50,000 cfu/mL
Total bacteria	<100,000 cfu/mL
Staphylococcus aureus	<5,000 cfu/mL

Adapted from McGuirk S: Herd-based testing for young stock. *Proc Am Assoc Bov Pract Conf* 38:146-148, 2005, and S Leadley, personal communication, December 2010.

should be done to find out where the colostrum is being contaminated.

To ensure that calves are getting the best colostrum, monitor periodically–proactively as well as when problems arise. Ensure that the farms have:

- Proper udder preparation
- Collection in clean, sanitized buckets
- Clean calf-feeding equipment (esophageal feeder, buckets, nipples, bottles)
- If not fed within one hour of collection, prompt refrigeration for up to one week (without additives) or freezing for up to one year. Watch freeze-thaw cycles.

Waste Milk Management: Monitoring Pasteurizers

More and more producers are shifting towards using pasteurized waste milk over milk replacers. Research has shown that calves grow better on whole milk than on traditional 20-20 milk replacers.[4] As the price for milk replacer increases and the push for milk quality increases, more use of pasteurizers can be expected. Producers can utilize pasteurizers as way to "use" the milk from chronic mastitis offenders or cows recovering from an acute mastitis, thereby reducing their bulk tank somatic cell-count (SCC).

One important thing to remember about pasteurizers is that while they reduce bacterial load, they do not sterilize milk.[4] Based on FDA standards for juice pasteurization, it was suggested that a 5-log reduction in bacteria counts was reasonable. Some believe this may be too stringent, proposing instead that a 50% log reduction could be used and should yield milk with acceptable counts.[1] If the initial count is 1,000,000, a 50% log reduction is 1,000 (6-log initial, 3-log final); for an initial count of 10,000, a 50% log reduction is 100 (4-log initial, 2-log final).

We can monitor pasteurized milk in a similar manner to that of the colostrum samples. Quantitative sampling is performed for pre-pasteurized milk, post-pasteurized milk, and pre-feeding milk. Mycoplasma

can also be monitored with pasteurizer samples if there is an issue with mycoplasma on the farm.

The pre-pasteurized milk must be diluted quantitatively to ensure that the proper counts can be detected. Start by making two tubes of standard ten-fold dilutions (-1 and -2). To make the -1 dilution tube, add 1 mL of the milk to 9 mL sterile water. To make the -2 dilution tube, take 1 mL of the -1 dilution tube and add to 9 mL of sterile water. Plate according to the table below (Table 3).

Dilutions of the post-pasteurization and pre-feeding samples are unnecessary; theoretically, the counts should be low enough to count without having to make dilutions. Plate 100 and 10 microliters of pre-feeding and post-pasteurized milk on blood agar plates, and 100 microliters on MacConkey plates. To calculate the final cfu/mL, multiply the colony count by the dilution factor as previously described for quantitative colostrum culturing. The pre-feeding sample should be taken from the last calf fed. This gives an indication of the sanitation of buckets and tanks used to transfer milk. Some increase in colony counts is to be expected, but should be less than 50,000 cfu/mL.[4]

Ideally there would be no growth at 48 hours, although this is not very common. Suggested goals for final pre-feeding counts range from less than 10,000 cfu/mL to 50,000 cfu/mL total bacteria, and less than 5,000 cfu/mL coliforms,[3,5,9] although some suggest that staphs and streps have to exceed one quarter million before health effects are seen (S Leadley, personal communication, December 2010).

Troubleshooting Pasteurizers

- Waste milk either pasteurized within two hours or cooled (if cooling will take longer and more energy to pasteurize)[4]
  - Excessive holding times (>40°F (4.4°C) prior to pasteurization) can cause excessively high pre-pasteurized counts, thereby making the post-pasteurized counts too high
- Verify temperature and time of pasteurization run (thermometer and stopwatch)
- Proper cleaning of pasteurizer (batch) and collection equipment[4,6]
  - Flush with water after emptying,
  - Scrub with 167°F (75°C) water and detergent, sodium hypochlorite, to provide 110 ppm chlorine,
  - Water rinse and acid sanitizer,
  - Drain and cover to prevent exposure to flies
- Milk fed within one hour post-pasteurization, otherwise milk should be cooled to <40°F (4.4°C).

Conclusions

With proper monitoring, quality colostrum and pasteurized waste milk can successfully be delivered to calves. Evaluation of pasteurized milk and colostrum milk should not be done just when calves are sick or dying, but rather routine and proactive screening should be done to address issues before they create problems. Set up schedules with the herd veterinarian based on the farm's history and personnel. Farms may need reminders to ensure regular, successful monitoring. A phone call or email the day before a herd visit helps ensure that appropriate samples are waiting for the veterinarian on herd health day.

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Table 3. Adapted from QMPS (Quality Milk Production Services), personal communication, November 2005.

Dilution tube number	Volume plated	Final effective dilution	Media (BAP-Blood Agar, MAC-MacConkey Agar)
-1	100 microliters	-2	BAP
-1	10 microliters	-3	BAP, MAC
-2	10 microliters	-4	BAP