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Cleaning Coliform Bacteria from Feedlot Water Tanks

David R. Smith
University of Nebraska-Lincoln, dsmith8@unl.edu

Todd Milton
University of Nebraska-Lincoln

Rodney A. Moxley
University of Nebraska-Lincoln, rmoxley1@unl.edu

Jeff Gray
University of Nebraska-Lincoln

Laura Hungerford
University of Nebraska-Lincoln

See next page for additional authors

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David Smith
Todd Milton
Rodney Moxley
Jeff Gray
Laura Hungerford
Doreen Bailey
Tony Scott
Terry Klopfenstein[1]

Routine cleaning or disinfection may not, by itself, reduce the likelihood of transmitting coliform bacteria to cattle through water tanks.

Summary

Three methods of physically or chemically cleaning feedlot water tanks were tested for their ability to reduce amounts of coliform bacteria in the water and biofilm during the summer months. Draining and refilling or draining, scrubbing and refilling water tanks did not reduce coliform bacteria in water or biofilm. Coliform bacteria in water and biofilm were reduced 99% and 99.9%, respectively, after draining, scrubbing and 15 minutes of chemical disinfection with chlorine bleach and refilling. However, coliforms returned to pretreatment levels 24 to 48 hours after treatment if cattle continued to drink from the tanks.

Introduction

Some have speculated that the transmission of *Escherichia coli* O157:H7, or other enteric pathogens between cattle might be reduced by routine cleaning of feedlot water tanks (Hancock et al. 1997 Compend Cont Ed Pract Vet. pp S200-S207). The objective of this study was to determine if levels of coliform bacteria in water and biofilm from feedlot water

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tanks could be reduced, and for how long, by any of three methods of physical or chemical cleaning.

Procedure

Microbiology

By definition, coliform bacteria include aerobic or facultative, nonsporeforming gram-negative rods that ferment lactose and form acid and gas within 48 hours at 35°C (Hitchins et al, 1992, American Public Health Assoc. pp 326). This group includes *E. coli* O157:H7. The coliform bacteria density of water and biofilm was estimated as the most probable number of coliform bacteria per 100 ml (MPN of coliforms) (APHA, 1995 American Public Health Assoc. pp 9-44) from samples obtained before and after the treatments. Cleaning efficacy was measured as: 1) the change in each tank's MPN of coliforms in water or biofilm from before to immediately following cleaning; 2) the change in each tank's MPN of coliforms in water from before to 24 hours after cleaning; and 3) the change in each tanks MPN of coliforms from immediately following cleaning to 24, 48 and 96 hours after cleaning.

Statistics

The logarithmic values of the MPN of coliforms were used for all statistical analyses. Differences in the pre-treatment coliform levels and cleaning efficacy were tested by paired t-test, one-way analysis of variance (ANOVA) using Tukey's HSD to separate means, or repeated-measures ANOVA as appropriate for the hypothesis.

Trial 1

Three methods of cleaning were assigned systematically to six feedlot water tanks for three periods at three week intervals (six repetitions of three methods) as follows:

- Method 1) water tank was drained and refilled
- Method 2) water tank was scrubbed with a brush to remove any visible biofilm, drained and refilled
- Method 3) water tank was scrubbed with a brush as above, drained and refilled. Household chlorine bleach (5.25% Na hypochlorite) was added to the water tank to a final 1:32 dilution. The disinfectant solution was kept in the tank for 15 minutes before the tank was drained again and refilled.

Trial 2

The hypothesis tested was that the change in MPN of coliforms after chemical disinfection (bacterial regrowth) would be different in water tanks with cattle drinking from them compared to tanks in empty feedlot pens because of additional contamination of the water with bacteria or substrate by cattle drinking from the tanks.

Twelve water tanks were scrubbed and chemically disinfected (using cleaning method 3, Trial 1). Cattle were removed from access to six of the water tanks when the tanks were cleaned; cattle continued to drink from the remaining six water tanks. The MPN of coliforms were calculated from cultures of the water and biofilm before and immediately following cleaning and from cultures of water 24, 48, 72 and 96 hours after cleaning.

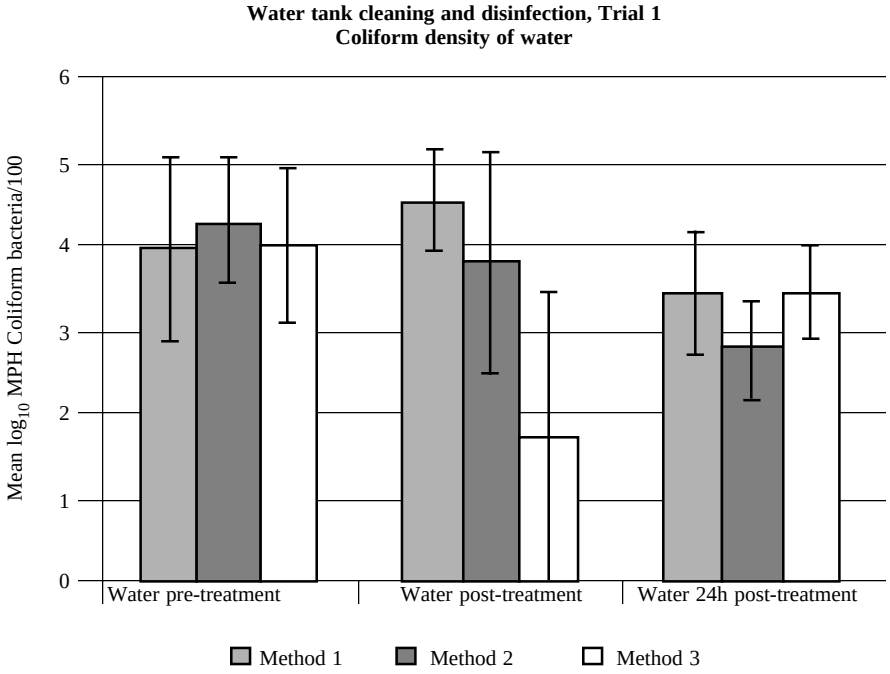

Figure 1. Most probable number (MPN) of coliform bacteria per 100 ml in water collected from feedlot water tanks cleaned by draining (Method 1, n=6), scrubbing and draining (Method 2, n=6), or scrubbing, draining and chemical disinfection (Method 3, n=6). Cleaning by method 3 significantly reduced the coliform bacteria in the biofilm immediately after treatment (P=.0003). Coliform levels at 24 hours were not different from pre-cleaning levels for any cleaning method (P=.12). Error bars show 1 standard deviation.

Results and Discussion

Trial 1

The MPN of coliforms in the water collected immediately after treatment from tanks cleaned with chemical disinfection (method 3) was reduced (P=.0003) on average more than 99% (mean $10^{2.3}$ -fold reduction). The other cleaning methods did not reduce the MPN of coliforms in the water. The MPN of coliforms of the water collected from tanks at 24 hours post-treatment was not significantly different from the respective pre-treatment level regardless of the cleaning method (Figure 1, P=.12). Similarly, the MPN of coliforms of the biofilm in tanks cleaned with chemical disinfection was reduced (P<.0001) on average more than 99.9%

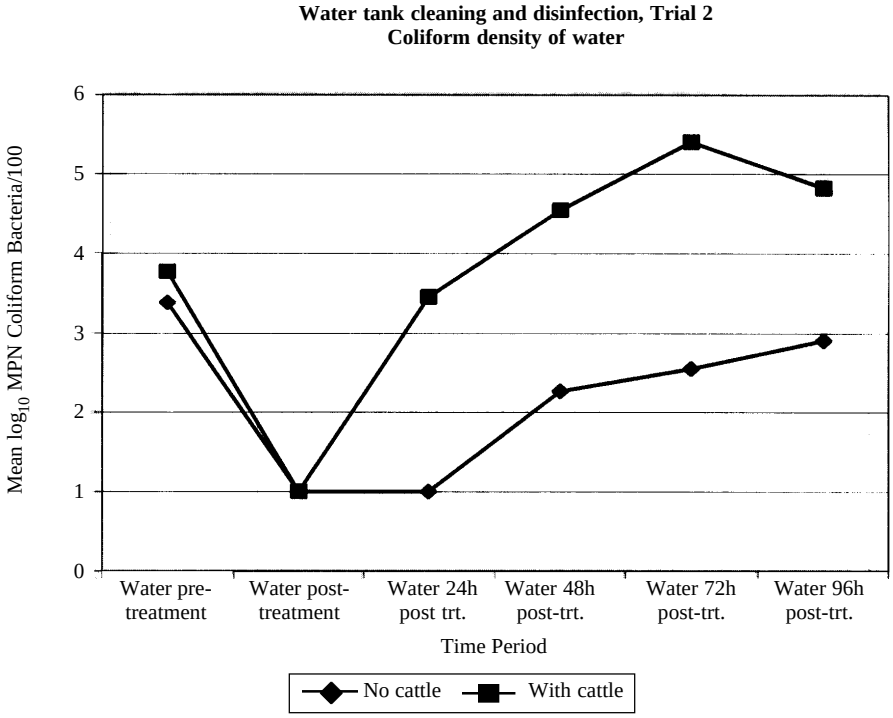

Figure 2. Most probably number (MPN) of coliform bacteria per 100 ml in water collected from six feedlot water tanks exposed (and six not exposed) to cattle after cleaning by scrubbing, draining and chemical disinfection. Coliforms in water (and biofilm) were reduced after treatment (P<.0001). Coliform levels in water increased with time after cleaning (P<.0001) and the coliform levels were higher in tanks with cattle access (P=.0003).

(mean $10^{3.6}$ -fold reduction). The MPN of coliforms of the biofilm in tanks physically cleaned was not significantly reduced.

Trial 2

The MPN of coliforms in water and biofilm were reduced immediately after water tank disinfection by averages of more than 99% (Figure 2) and 99.999%, respectively (P<.0001). The MPN of coliforms in the water increased in both groups following disinfection (P<.0001); however, during the four days after cleaning, the MPN of coliforms in water that cattle were drinking from was nearly 100-fold greater than water without cattle access (P=.0003, Figure 2).

The post-treatment rise in the MPN of coliforms measured in Trial 1 may have been due to introduction of bacteria and/or substrate into the water by cattle drinking from the tanks, or from regrowth of bacteria remaining in the water and biofilm. Trial 2 was designed to test if bacterial regrowth was directly from the tank or from recontamination by cattle. In Trial 2 coliform regrowth occurred within days of cleaning the tanks regardless of cattle access, but the magnitude of coliform regrowth was 100-fold greater in water from which cattle were drinking. These data indicate that coliform bacteria rapidly populate water tanks in the summer because cattle recontaminate them with coliform bacteria and/or substrate.

There may have been unmeasured shifts in the types of coliform bacteria repopulating the water tanks after cleaning and chemical disinfection of water tanks, so it is possible that populations of pathogenic bacteria were affected differently than other coliform bacteria. But, if the overall number of coliforms in a water tank reflects the likelihood of transmitting coliform bacteria from water tanks to cattle, then the benefits of cleaning and disinfecting water tanks to minimize the transmission of coliform bacteria to cattle are short-lived. The practice of cleaning feedlot water tanks is important for palatability and for other water quality reasons, but routine cleaning and disinfection may not, by itself, reduce the likelihood of transmission of coliform bacteria to cattle through water tanks.

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[1]David Smith, assistant professor, Veterinary and Biomedical Sciences, Lincoln; Todd Milton, assistant professor, Animal Science, Lincoln; Rodney Moxley, professor, Jeff Gray, assistant professor, Laura Hungerford, associate professor, Doreen Bailey, research technician, Veterinary and Biomedical Sciences, Lincoln; Tony Scott, graduate student, Terry Klopfenstein, professor, Animal Science, Lincoln.