A risk-oriented evaluation of biofilm and other influencing factors on biological quality of drinking water for dairy cows

Jason J Hayer ,
Céline Heinemann ,
Benedikt G Schulze-Dieckhoff ,
Julia Steinhoff-Wagner

Journal of Animal Science, Volume 100, Issue 5, May 2022,
skac112, https://doi.org/10.1093/jas/skac112
Published: 07 April 2022

Abstract

Despite the importance of livestock drinking water quality on animal physiology, welfare, and performance, influences such as biofilm formation on trough surfaces on microbial water quality are rarely researched. The objective of this study was to assess the microbial quality of water offered to lactating dairy cows and identify risk factors for poor water quality. We further aimed to determine the impact of biofilm formation on water quality and evaluate rapid test systems to score the hygiene status of dairy troughs on the farm. A total of 105 troughs located on 24 typical Western German dairy farms were sampled. Samples of livestock drinking water and biofilm were analyzed for aerobic total viable count (**TVC**), coliform count (**CC**), *Escherichia coli*, methicillin-resistant *Staphylococcus aureus* (**MRSA**), and other bacteria resistant to 3rd generation cephalosporins (**CRB**). Surface protein- and adenosine triphosphate (ATP)-rapid tests were evaluated to detect biofilm formation. The influence of 22 selected fixed and variable trough characteristics on impaired livestock drinking water quality was evaluated by calculating odds ratios. The average TVC, CC, and *E. coli* counts were 4.4 ± 0.06 (mean ± SD), 1.7 ± 0.1, and 0.6 ± 0.1 $\log_{10}$ cfu per mL, respectively. CC was detectable in 94.3% of all water samples and *E. coli* in 48.6%. MRSA was found in pooled livestock drinking water samples of a single farm and CRB on three farms, suggesting that troughs might function as a reservoir of antibiotic-resistant bacteria, thereby contributing to an exchange of antibiotic-resistant bacteria between animals. Risk factors for the impairment of at least one microbial quality criteria (TVC, CC, or *E. coli*) increased significantly ($P < 0.05$) when using high-volume troughs, other trough materials

than stainless steel, a lower distance to the milking parlor, heavy visible soiling, biofilm formation, and high ambient and high water temperatures. CC (r = 0.46; P < 0.001) and *E. coli* (r = 0.31; P < 0.01) of water samples correlated with their equivalent in biofilm and with the results of rapid tests on trough surfaces (0.31 > r > 0.19; P < 0.05). Addressing the identified risk factors could be an approach to ensure sufficient biological quality of livestock drinking water.

antibiotic-resistant bacteria, hygiene, rapid tests, risk assessment, water contamination, water troughs

Issue Section:
Animal Health and Well Being

Collection: ASAS Journals

Lay Summary

Although water is recognized as one of the most important nutrients for dairy cows, only limited research on its quality and potential risk factors for quality impairments is available. This study aimed to evaluate biological water quality on Western German dairy farms, identify potential risk factors for impairment, and evaluate rapid test systems to score the hygienic status of troughs. Water, biofilm, and trough surfaces of 105 water troughs on 24 dairy farms were sampled and analyzed. The bacterial load of sampled livestock drinking water was relatively high. Nearly half of all water samples were contaminated with *Escherichia coli*, and antibiotic-resistant bacteria were detectable on four farms. Identified risk factors for poor biological water quality that could be used to ensure sufficient water quality on-farm were: high-volume troughs, plastic or cast iron as trough material, a lower distance to the milking parlor, heavy visible soiling, biofilm formation, and high ambient and high water temperatures. Rapid test systems to evaluate trough surfaces correlated with biofilm and water analysis results and could be a useful tool for farmers to check water quality on-farm.