

Factors Associated with Antimicrobial Resistance Patterns in Fecal *Escherichia coli* from Minnesota Dairy Calves from Birth to Four Months of Age

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Introduction

Antimicrobial resistance, and the potential for transmission of resistant zoonotic pathogens from animal sources to humans, continues to be a heavily debated topic. We need to improve our understanding of factors on dairies that contribute to the development or shedding of resistant pathogens, so that veterinarians and producers can adopt judicious drug use and animal management practices that will ultimately protect both animal and human health. The objective of this study was to describe the relationship between the type of milk diet fed, age of calf, and systemic treatment with antimicrobials, and levels of antibiotic resistance in fecal *E. coli* from dairy calves between birth and four months of age.

Materials and Methods

During the summer of 2009, 15 commercial Holstein dairy farms were recruited into a cohort study based on the type of milk diet fed to preweaned calves (five farms per diet type): 1) pasteurized non-saleable milk, 2) medicated milk replacer, or 3) non-medicated milk replacer. Newborn calves (five per farm) were recruited in the first week of life and systemic antimicrobial treatment events were recorded between birth and 16 weeks of age. Fecal samples were collected from these calves during the first, third, fifth, and 16th week of age for isolation and antimicrobial resistance testing (MIC, Sensititre method) of fecal *E. coli* (293 fecal samples collected; 871 *E. coli* isolates tested). From the MIC test results, *E. coli* isolates were classified as being either susceptible (S), intermediate (I), or resistant (R) to each of the following 10 antimicrobials: ampicillin, ceftiofur, enrofloxacin, florfenicol, gentamicin, neomycin, oxytetracycline, sulfadimethoxime, tilmicosin, and trimethoprim/sulphamethoxazole. A total resistance score was then created by summing the total number of antimicrobials to which the isolate was resistant (possible resistance score = 0 to 10). Mixed linear regression was used to describe the relationship between the resistance score for each isolate, and the following explanatory variables of

interest: type of milk diet fed (pasteurized non-saleable milk, medicated milk replacer, non-medicated milk replacer), age of calf (1, 3, 5, or 16 weeks), and recent systemic treatment with an antimicrobial (yes/no).

Results

Least square mean results showed that antimicrobial resistance scores at weeks 1, 3, and 5 were higher for *E. coli* isolates from calves fed either medicated milk replacer (wk 1 = 6.0; wk 3 = 7.1; wk 5 = 7.3) or pasteurized non-saleable milk (wk 1 = 5.2; wk 3 = 7.1; wk 5 = 5.2), as compared to *E. coli* isolates from calves fed non-medicated milk replacer (wk 1 = 3.4; wk 3 = 4.1; wk 5 = 3.6) ($P < 0.0001$). However, there was no difference in *E. coli* resistance scores among the three milk diets at week 16 (post-weaning) (medicated MR = 3.3; non-saleable milk = 2.8; non-medicated MR = 3.0; $P > 0.05$). *E. coli* resistance scores were significantly lower for all post-weaned calves (wk 16 = 3.3) as compared to pre-weaned calves (wk 1 = 5.2; wk 3 = 6.2; wk 5 = 5.3) ($P < 0.0001$). *E. coli* resistance scores were higher if the calf had been treated systemically with an antimicrobial within the 14-day period preceding the sampling event (5.4), as compared to calves that were treated more than 14 days preceding the sampling event or had never been treated (4.6) ($P = 0.0052$).

Significance

We hypothesized that once antimicrobial exposure is removed (e.g. after weaning from a medicated milk diet), the selective pressure for resistant bacteria is decreased, allowing susceptible bacteria to flourish again and resulting in a greater likelihood for recovering susceptible *E. coli* isolates when sampling calves. The results of this research may serve to guide farm-level management practices for preweaned calves, as well as to increase awareness in farm workers and the public of the need for sanitation when exposed to young calves on farms, at fairs or in petting zoo settings.