Effects of parturition on fecal coliform shedding from dairy cows.

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Abstract:
Periparturient cows have a high incidence of intramammary infection (IMI) and clinical mastitis caused by coliform bacteria. Susceptibility has been associated with immunosuppression, as well as environmental factors. Increased IMI rates have been correlated with an increased number of coliform bacteria in bedding and the bacterial burden in bedding has been associated with warmer weather and increased moisture. We were interested in whether changes in feed intake and increases in fecal coliform shedding occurred during periods of elevated coliform IMI rates. Fecal coliform shedding was measured in two studies monitoring a total of 12 multiparous Holstein cows. Fecal samples were obtained per rectal palpation 4 weeks prepartum through 2 wks postpartum, serially diluted, plated on MacConkey's agar, and colonies were counted after incubation (18 h). Samples were obtained 3 days/wk and sampling frequency increased to daily as expected calving date approached. In all 12 cows, shedding of coliform bacteria was low to undetectable 4 wks prior to parturition, however, near calving total fecal coliform numbers increased by 10^4-10^7 cfu/g feces. Nine of twelve cows peaked within 7 days of calving, and the other three showed sharp increases within 12 days of calving. Surprisingly, no association with feed intake changes was observed. Furthermore, despite periods of elevated total fecal coliform numbers, testing for E. coli O157:H7 yielded no positive cultures on selective media. The observed increases in shedding of fecal coliform bacteria may contribute to the increased rates of new IMI caused by coliform bacteria in periparturient cows.

Introduction:
Clinical mastitis, caused by environmental pathogens,1,2 is the number one mastitis problem for well-managed dairies with low somatic cell counts.3 In particular, periparturient cows have a high incidence of new intramammary infection (IMI) and clinical mastitis caused by coliform bacteria. Greater than 75% of E. coli IMI were associated with parturition and the immediate postpartum period.4 Susceptibility has been associated with immunosuppression in periparturient cows, environmental factors, parity, bedding, and season.2,5-7 Furthermore, there is evidence that animals deprived of feed show dramatic increases in coliform shedding.8,9 Most periparturient cows exhibit a 15-30% decline in dry matter feed intake near parturition.10 One specific coliform, Escherichia coli O157:H7, has been the cause for concern in the food safety industry. E. coli O157:H7 was first identified as a human pathogen following two outbreaks of hemorrhagic colitis in the United States in 1982, where an association between illness and contaminated hamburger was established.11 Despite other routes of contamination, cattle continue to be implicated as a significant reservoir. Although work has been done with experimentally infected animals, the duration of infection and magnitude of shedding of naturally occurring E. coli O157:H7 in cattle needs further definition. Therefore, the objectives of this study were: 1) To investigate whether fecal coliform shedding in dairy cows increases during the periparturient period and to assess any correlation between feed intake changes and fluctuation in numbers of fecal coliforms, and (2) to monitor for E. coli O157:H7.

Materials and Methods:
Two studies were conducted to monitor shedding of coliform bacteria in feces of 12 periparturient cows. In both studies, fecal samples were obtained per rectal palpation @ 0700 hrs from 3 days/wk up to 7 days/wk as calving date approached. Within one hr of collection fecal samples were diluted (1 gm feces/5 ml phosphate buffered saline (PBS)) and vortexed for 1 minute. Serial dilutions in PBS were made and 0.1 ml aliquots were plated on sorbitol
MacConkey's agar and incubated @ 37 degrees C for approximately 20 hrs. In the first study, samples were obtained from 5 pregnant Holstein cows approximately 4 weeks prepartum through 3 days postpartum. Sampling for E. coli O157:H7 was also done on days following a day of detecting elevated total fecal coliform shedding. In the second study, samples were obtained from 7 pregnant Holstein cows beginning approximately 4 weeks prepartum and continuing through 2 weeks postpartum. Additionally, two nutritionally-balanced rations were designed for the end of gestation and the early lactating period, respectively, and daily feed intake was recorded.

Results:
Study 1:
1) In each of the 5 cows, shedding of fecal coliform bacteria was relatively constant (±2 log10) throughout most of the prepartum period, and a range of 0 - 7% of the samples resulted in coliforms being completely undetectable. However within 7 days of parturition, 4 of the 5 cows exhibited a 10^4 - 10^7 cfu/gm of feces increase in fecal coliform shedding. See Figure 1 for 2 representative cows out of 5. Note that the Y axes are different due to the variability of each cow.

2) No E. coli O157:H7 isolates were found on selective media despite periods of elevated total coliform shedding in feces.

Study 2:
1) Similar to study 1, 7 of 7 cows experienced relatively constant coliform bacteria levels in feces, with 0 - 8% of all samples resulting in undetectable levels of coliforms; however, within 12 days of parturition all cows showed an increase of 10^4 - 10^7 cfu/gm of feces. See Figure 2 for 2 representative cows out of 7. Note that the Y axes are different due to the variability of each cow.

2) No consistent correlation was seen between fluctuations in feed intake and coliform shedding.

Discussion and Conclusions:
Periparturient cows in our study experienced low, and at times, undetectable levels of fecal coliform shedding with a dramatic increase in coliform numbers near parturition. We were unable to detect E. coli O157:H7 in any of the fecal samples from these animals. Our data demonstrate that coliform bacteria in feces are not uniformly shed, nor do all cows shed at similar levels. Regardless of level of shedding, all 12 cows experienced a 10^4-10^7 cfu/gm of feces increase in fecal coliform shedding within 12 days of parturition. The increase does not seem to be related to feed intake. The increased shedding of fecal coliforms seen near parturition may contribute to the high rate of new IMI of periparturient cows.

From a food safety perspective, the reliability of using E. coli as a monitor for fecal contamination may be questionable. Recently the USDA Food Safety and Inspection Service has required licensed slaughter plants to test carcasses for E. coli as an indicator of the plants' process control for fecal contamination. Due to the fluctuating levels of coliform shedding in our study, particularly those sampling days where coliforms were completely undetectable, our results may prove this indicator for fecal contamination is less than 100% accurate. Lack of E. coli detection for fecal contamination may therefore, provide a false negative for fecal contamination.

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Questions and Answers