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Longitudinal Patterns of Fecal Shedding of *Escherichia coli* O157:H7 by Feedlot Cattle

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The percentage of cattle shedding *Escherichia coli* O157:H7 varied from 1% to 80% over the feeding period with every animal shedding the organism at least once.

Summary

To describe the prevalence, incidence, and duration of fecal shedding of E. coli O157:H7, 99 feedlot steers were individually tested each week of the feeding period for presence of E. coli O157:H7 in rectal feces. E. coli O157:H7 was recovered from each animal at least once during the study. Both the incidence and mean duration of shedding peaked during the middle of the feeding period. The percentage of cattle shedding E. coli O157:H7 ranged from 1% to 80% over the course of the feeding period and was affected by both the incidence and the duration of shedding.

Introduction

Studies of *Escherichia coli* O157:H7 in feedlot cattle have demonstrated that the organism is common within groups of feedlot cattle (*2001 Beef Report*, pp. 81-84, Elder et al., 2000. Proc Natl Acad Sci USA, pp. 2999-3003). In studies conducted in commercial feedyards we found the percentage of cattle shedding *E. coli* O157:H7 did not differ between the feedyards, but within feedyards the percentage of cattle shedding *E. coli* O157:H7 within a pen varied greatly (*2001 Beef Report*, pp. 81-84). Since each pen of cattle in that study was tested only once we were unable to monitor changes in prevalence over time. The objective of this study was to describe prevalence, incidence, and duration of fecal excretion of *E. coli* O157:H7 by a defined group of feedlot cattle over the course of the feeding period.

Procedure

The study was designed as a longitudinal study to monitor individual cattle for the presence of *E. coli* O157:H7 in rectal feces. One hundred steers were randomly assigned to 10 pens (10 animals each) upon arrival to the research feedyard at the Agricultural Research and Development Center, University of Nebraska-Lincoln, Ithaca, Neb. The steers were fed a high concentrate finishing diet for 136 days starting in June 2000. One animal was removed from the study during the seventh week because of its behavior. The cattle were tested once each week for 19 weeks. Feces were collected from the rectum of each animal in each pen while they were restrained in a handling chute. The samples were immediately transported to the University of Nebraska-Lincoln and tested for the presence of *E. coli* O157:H7. Culture methods were specific for the detection of *E. coli* O157:H7 in fecal specimens and included selective enrichment, immunomagnetic separation and confirmation of suspect isolates by standard methods (*2001 Beef Report*, pp. 81-84).

Incidence was defined as the number of cattle shedding *E. coli* O157:H7 whose feces had been culture negative the previous week divided by the number of animals that were culture

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negative the previous week. The duration of shedding was defined as the number of consecutive weeks an individual animal was shedding a detectable level of the organism. Each animal could have more than one incident of shedding over the course of the feeding period, each with its own duration. Prevalence was defined as the proportion of cattle shedding a detectable level of *E. coli* O157:H7 on any given sampling date.

On two of the sampling dates, weeks 11 and 17, the shedding status of many cattle was not reliably determined because the culture media may have contained inappropriate concentrations of antibiotics inhibiting isolation of the organism. These cattle were assigned values for the missing observations based on the culture results from the week before and after. Animals were considered positive for fecal shedding of the organism on those dates if *E. coli* O157:H7 was isolated from their feces both the week before and the week following and otherwise considered negative.

Results

E. coli O157:H7 was recovered at least once from the feces of each animal that completed the study. The point-prevalence of cattle shedding the organism ranged from 1% (1 animal) on the first sampling date, three days following assignment to pens, to 80% (80 animals) during the tenth week of the study (Figure 1).

The first seven weeks of the feeding period were characterized by low incidence (<0.1 new cases/animal-week) of fecal excretion of *E. coli* O157:H7 with short mean duration of shedding the organism (≤2.5 weeks). Over the feeding period, the incidence increased dramatically in week nine (0.5 new cases/animal-week), reached the highest rate in week 14 (0.7 new cases/animal-week), and gradually decreased during the last five weeks of the study (Figure 2). Because new cases of shedding were not described for the proportion of samples affected by the media in weeks 11 and 17, incidence may have been underestimated for those two weeks. The mean duration of fecal shedding was longest through the middle of the feeding period, with cases starting in weeks eight and nine lasting 4.7 and 4.8 weeks, respectively (Figure 2).

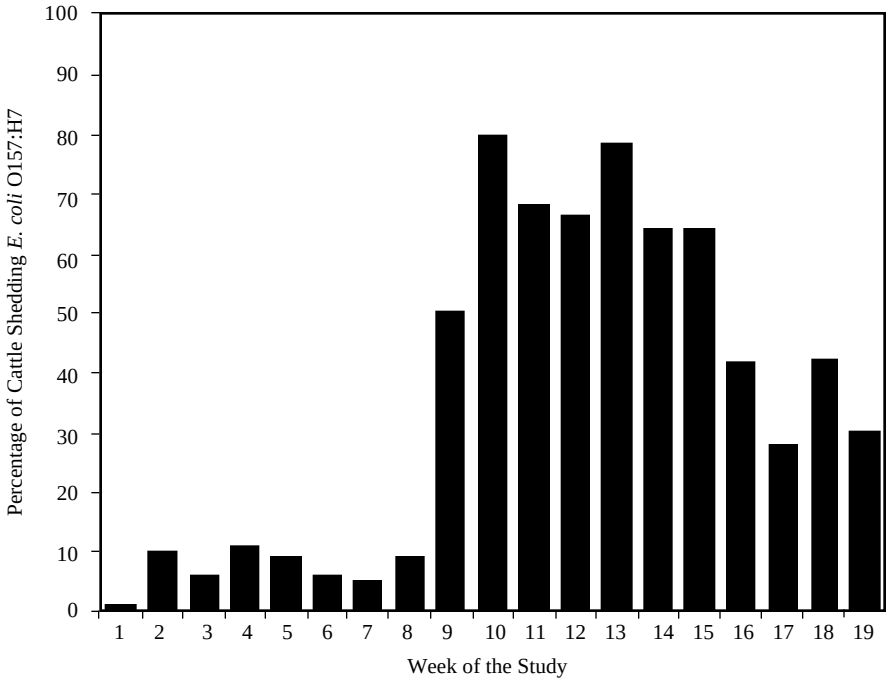

Figure 1. Percentage of cattle shedding a detectable level of *E. coli* O157:H7 during each week of the feeding period (June 2-Oct. 9, 2000).

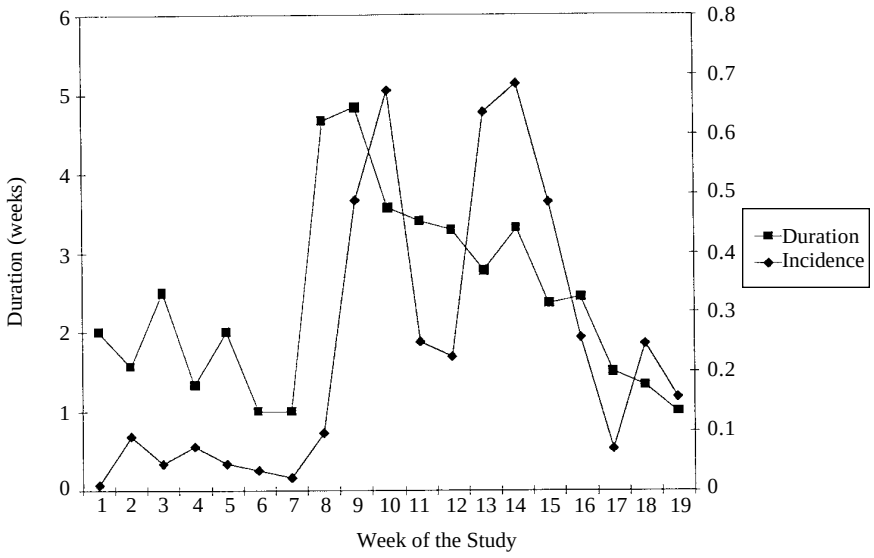

Figure 2. Incidence (new cases/animal-week) and duration (average number of consecutive weeks) of fecal shedding of *E. coli* O157:H7 by feedlot cattle for each week during the feeding period (June 2-Oct. 9, 2000).

On the last sampling date, 30% of the steers were excreting a detectable level of *E. coli* O157:H7 in their feces and these animals had been shedding the organism for a mean of 3.4 weeks. On this date, at least one animal was shedding the organism in nine out of the 10 pens. Ninety percent of the animals in one pen, 40% of the animals in three pens, 30% of the animals in one pen, 20% of the animals in two pens, and 10% of the animals in two pens were culture positive for *E. coli* O157:H7.

The prevalence of fecal shedding of a detectable level of *E. coli* O157:H7 within a given group of feedlot cattle varied widely over the feeding period and the variability in prevalence was a function of changes in both incidence and duration of fecal shedding.

E. coli O157:H7 appeared to be ubiquitous to this group of cattle since the organism was recovered at least once from each animal and the organism was detected from at least one animal every week of the study. It is interesting that the range of prevalence for cattle shedding *E. coli* O157:H7 in this longitudinal study was nearly identical to the range of prevalence we previously observed in a cross-sectional study of commercial feedlot cattle (*2001 Beef Report*, pp. 81-84). Identifying the factors that explain the difference between groups of cattle with high or low prevalence may be useful for devising a control strategy on farms to enhance food safety. Some of those factors may vary with time just as the prevalence of shedding does. Additional studies are in progress to identify time-dependent factors that explain fecal shedding of *E. coli* O157:H7 by feedlot cattle.

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