Research Note

Prevalence of Escherichia coli O157 in Cattle and Swine in Central Mexico†

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MS 04-98: Received 12 March 2004/Accepted 23 April 2004

ABSTRACT

Escherichia coli O157:H7 is a foodborne pathogenic bacterium that can reside undetected in the gastrointestinal tract of cattle because colonization by this bacterium is asymptomatic. Recent research has indicated that swine can carry and transmit this pathogen as well. The development of more advanced and sensitive detection techniques has improved the limit of detection and increased sensitivity for this important pathogen. This study was undertaken to determine the prevalence of E. coli O157 in cattle and swine in Mexico with the more sensitive detection technique of immunomagnetic bead separation. Samples (n = 60 per farm) were taken from four cattle and four swine farms (n = 240 cattle samples, n = 240 swine samples) located throughout central Mexico in October 2001. The prevalence of E. coli O157 was found to be only 1.25% on cattle farms and 2.1% on swine farms. The prevalence in cattle in this study is lower than that reported in the United States and could be related to the lower reported prevalence of E. coli O157 in humans in Mexico. However, further research is needed to verify prevalence throughout other regions of Mexico, as well as prevalence during other seasons of the year.

Escherichia coli is a common member of the intestinal microflora of animals and man (8). Most strains of E. coli live in a symbiotic relationship with the host animal; however, E. coli O157:H7 and related strains can cause severe illness or even death in humans (16). The primary symptom of E. coli O157:H7 infection in humans is severe bloody diarrhea (hemorrhagic colitis) (15). Thus, E. coli O157:H7 and related strains are categorized as enterohemorrhagic E. coli (EHEC) and cause over 93,000 illnesses in the United States at an estimated cost of more than $1 billion each year (21).

Ruminant animals, especially cattle, are a primary reservoir of E. coli O157:H7 and other EHEC (1, 4, 19). Many human EHEC outbreaks have been linked to food products derived from animals or to contact with ruminant animals or their wastes. However, swine can also harbor EHEC that infect humans (2, 17, 20). Recently, it has also been demonstrated that E. coli O157:H7 can be horizontally transmitted between swine housed under confinement conditions (7).

Although there has been much research into the prevalence of E. coli O157 in food animals in the European Union and the United States, there has been little research into the prevalence in animals in other nations. The limited research performed to examine the prevalence in other nations was conducted prior to the introduction of more sensitive, molecular-based techniques. Therefore, this study was undertaken to determine the prevalence of E. coli O157 in cattle and swine in Mexico by the more sensitive and specific immunomagnetic separation detection method.

MATERIALS AND METHODS

Sample collection. Cattle farms (n = 4) and swine farms (n = 4) were sampled at eight different locations across central Mexico (Table 1). Both dairy (n = 2 farms) and beef cattle (n = 2 farms) were sampled. Dairy farms were typical drylot facilities, feeding a mixture of grain and silage; beef cattle were pasture fed. Swine samples were obtained from farrowing facilities (n = 1), finishing facilities (n = 2), and a complete farrow-to-finish facility (n = 1).

Fresh fecal samples (~25 g each) were collected aseptically from 60 animals on each farm for a total of 240 cattle and 240 swine sampled. Each sample was collected per rectum with a new palpation sleeve for each sample. Each fecal sample was placed into a sealed bag and maintained on ice for less than 24 h until returned to the laboratory for immediate processing and enrichment.

Sample enrichment. Samples (5 g) were added to GN-Hajna broth (45 ml, Difco, Becton Dickinson, Sparks, Md.) supplemented with vancomycin (8 µg/ml), cefoxime (1.42 µg/ml), and...
TABLE 1. Escherichia coli O157 isolated from feces from cattle or swine farms across central Mexico

<table>
<thead>
<tr>
<th>Farm location</th>
<th>Animal species</th>
<th>E. coli O157-positive samples/total fecal samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Xalapa, Veracruz</td>
<td>Cattle</td>
<td>0/60</td>
</tr>
<tr>
<td>Texcoco, Mexico</td>
<td>Cattle</td>
<td>1/60</td>
</tr>
<tr>
<td>Bernal, Quintana Roo</td>
<td>Cattle</td>
<td>2/60</td>
</tr>
<tr>
<td>Mexico, D.F.</td>
<td>Cattle</td>
<td>0/60</td>
</tr>
<tr>
<td>Total</td>
<td>Cattle</td>
<td>3/240 = 1.25%</td>
</tr>
<tr>
<td>Xalapa, Veracruz</td>
<td>Swine</td>
<td>0/60</td>
</tr>
<tr>
<td>Axapusco, Mexico</td>
<td>Swine</td>
<td>2/60</td>
</tr>
<tr>
<td>San Miguel de Allende, Guanajuato</td>
<td>Swine</td>
<td>3/60</td>
</tr>
<tr>
<td>Mexico, D.F.</td>
<td>Swine</td>
<td>0/60</td>
</tr>
<tr>
<td>Total</td>
<td>Swine</td>
<td>5/240 = 2.08%</td>
</tr>
</tbody>
</table>

cesfoduln (10 µg/ml) and were incubated for 6 h at 37°C according to the method of Keen and Elder (13). Following the initial enrichment, samples were quickly cooled to 4°C and stored at 4°C until the immunomagnetic bead separation procedure could be performed (<36 h).

Immunomagnetic bead separation and identification. Previously enriched samples were enriched secondarily for E. coli O157:H7 with the use of Dynal immunomagnetic beads (Dynal bead anti-E. coli O157:H7, Dynal Inc., Lake Success, N.Y.; Neogen Corporation, East Lansing, Mich.) and were plated on CHROMagar O157 selective medium (DRG Incorporated, Mountainside, N.J.) following the method of Keen and Elder (13). CHROMagar plates were incubated at 37°C overnight. Pink colonies on the CHROMagar were classified as putative colonies and were aseptically picked and resuspended in phosphate-buffered saline (pH 7.0). Resuspended colonies were placed on O157-specific detection assay sticks (REVEAL for O157 Detection Kits, Neogen). Colonies that reacted positively with these assay kits were classified as E. coli O157.

RESULTS AND DISCUSSION

In the United States, the E. coli strain most commonly responsible for human outbreaks of hemorrhagic colitis has been E. coli O157:H7 (16, 21). Although more than 73,000 people are sickened each year by E. coli O157:H7 in the United States (21), evidence indicates that it is not an important human pathogen in Mexico (18). EHEC has been isolated on all continents; however, the specific EHEC strain that causes most human outbreaks does vary geographically.

Epidemiological studies that use culture-based methodologies have traditionally reported E. coli O157:H7 prevalence in cattle of 1 to 3% (11). However, the introduction of more advanced molecular techniques, such as immunomagnetic bead separation, has reduced the limit of detection and increased specificity for E. coli O157:H7, thus increasing its reported incidence in cattle (3, 5, 9). In the United States, approximately 28% of cattle were found to contain E. coli O157:H7 (9). Additional studies in Europe indicated that 18, 32, and 75% of dairy cows, sheep, and goats, respectively (22), and 20% of feedlot cattle in the Czech Republic shed EHEC (6). Other studies have demonstrated that approximately 40% of cattle slaughtered in Hong Kong contained EHEC (14). Therefore, it appears that EHEC is geographically widespread and is present at levels higher than previously thought.

Although ruminant animals have often been implicated as the primary sources of infection, research has implicated swine as a potential reservoir of E. coli O157:H7 (2, 17, 20). Early investigations with traditional culture-based methodologies indicated that less than 1% of swine carried E. coli O157:H7 (3); later culture-based results found a prevalence of less than 2% (17). PCR studies have further demonstrated that the prevalence of EHEC in swine in Hong Kong was a similar 2.1% (14). When DNA hybridization was used to detect EHEC, over 65% of swine were found to carry EHEC in Chile (2). The EHEC strains isolated from these swine did include O157:H7 isolates that were clonally related to isolates from human outbreaks (2, 20). In a study that used techniques similar to those employed in this study, researchers found that approximately 2% of U.S. swine carried E. coli O157:H7 (10). Thus it appears that swine might be a reservoir of E. coli O157: H7, but the size of this reservoir appears to be variable on the basis of geography.

Using the techniques described here, we observed a prevalence of from 10 to 30% E. coli O157 in cattle samples from various geographical regions of the United States during the same period (unpublished data). In this study, less than 2% of all fecal samples were found to contain E. coli O157 (Table 1). Only 1.25% of cattle samples and approximately 2% of the swine samples tested positive. More isolates were found in swine than in cattle, but this difference was not significant (P > 0.10).

The prevalence of E. coli O157:H7 shedding in cattle and the frequency of human outbreaks varies seasonally, with the highest prevalence during the summer months and lower prevalence (typically <10%) during the winter (11). During the summer, up to 80% of cattle can shed E. coli O157:H7 (12). This study was performed in October, a month when shedding is generally intermediate; however, because of the southern latitude of the survey, the ambient air temperatures were still quite warm. In this study, the prevalence of E. coli O157 in cattle was found to be lower than would be expected, but the prevalence in swine was similar to that reported previously for the United States and other nations.

These results indicate that there appears to be a lower prevalence of shedding of E. coli O157 from cattle reared in Mexico compared with cattle reared in the United States. Mexican swine were found to have a low prevalence of E. coli O157 shedding, similar to results from the United States. Further research is needed to examine whether the level of shedding by cattle is maintained in different regions of Mexico during different times of the year. Because human outbreaks and cattle carriage are closely linked, it appears that the low level of human prevalence of E. coli O157 in Mexico might be related to the lower prevalence of E. coli O157 in Mexican cattle. However, much more
research must be performed before this hypothesis can be evaluated effectively.

REFERENCES


