A 3-year study of Escherichia coli O157:H7 in cattle, camel, sheep, goat, chicken and beef minced meat

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Abstract. Escherichia coli O157: H7 is recognized as an important cause of diarrhea, hemorrhagic colitis and hemolytic-uremic syndrome worldwide. Meat, meat products, dairy products, vegetables and drinking water contaminated with animal feces are probably the major sources of the E. coli O157: H7 infection. The aim of the present study was to investigate the prevalence of E. coli O157: H7 in raw meat samples of in Iran. From April 2006 to November 2009, 484 raw meat samples were collected from cattle (n= 90) camel, (n= 75), sheep (n= 60), goat (n= 60), chicken (n= 82) and minced beef (n=117). Bacterial DNA extraction was performed after an enrichment step in a broth was followed by PCR. Twenty-three (4.8%) of 484 samples were positive for E. coli O157. Most of the E. coli O157 strains were isolated from cattle and beef minced meat samples. Of 23 E. coli O157 isolates, 8 were serotype O157: H7 and 15 were serotype O157: NM. The prevalence of this organism was different during different seasons. The highest incidence of E. coli O157:H7 occurred in summer and fall seasons. To our knowledge, this is the first report of the isolation of E. coli O157: H7 from retail raw camel meat in Iran. The data reported in this study provides some useful baseline in formation for future research.

Keywords: Escherichia coli O157: H7, raw meat, chicken meat, minced meat

1. Introduction

Escherichia coli O157:H7, raw meat, chicken meat, minced meat

There are four major pathogens that have frequently been associated with meat and meat products including Salmonella spp., Campylobacter spp., Listeria monocytogenes, and Escherichia coli O157:H7. These organisms have been linked to a number of cases of human illness [1]. One of the most significant food-borne pathogens that has gained increased attention in recent years is E. coli O157:H7. Typical illness as a result of an E. coli O157:H7 infection can be life threatening, and susceptible individuals show a range of symptoms including hemolytic colitis, hemolytic-uremic syndrome, and thrombotic thrombocytopenic purpura [2]. Domestic and wild animals are the sources of E. coli O157, but ruminants are regarded as the main natural reservoirs. Sporadic cases and outbreaks of human diseases caused by E. coli O157 have been linked to ground beef, raw milk, meat and dairy products, vegetables, unpasteurized fruit juices and water [3, 4]. Infections can also be acquired by direct contact with animals and by person-to-person spread [2, 5]. Currently, there is limited information regarding the prevalence of E. coli O157:H7 in animal meat in Iran. Therefore, this study was conducted to determine the contamination rate of E. coli O157:H7, from retail raw beef, camel, sheep, goat, chicken, and beef minced meat using PCR in Three cities of Iran.
2. Materials and methods

2.1. Sample collection and preparation

From April 2006 to November 2008, a total of 484 raw meat samples from beef (n = 90), camel (n = 75), sheep (n = 60), goat (n = 60), chicken (n= 82) and beef minced (n= 117) meat were purchased from randomly selected retail outlets in Isfahan, Shahrekord and Yazd, Iran. All samples were placed in separate sterile plastic bags to prevent spilling and cross contamination and were immediately transported to the laboratory in a cooler with ice packs.

2.2. Isolation of E. coli O157:H7

Twenty-five g of each sample were homogenized in 225 mL trypton soya broth supplemented with novobiocin (20 mg/L) and incubated at 37 °C for 18-24h.

Then the enrichment samples were streak onto levine eosin methylene blue agar and sorbitol McConkey agar plates supplemented with cefexime (0.5 mg/L) and potassium tellurite (2.5 mg/L) and incubated as above. Suspected colonies were confirmed by TSI agar and IMViC tests [6]. Sorbitol negative colonies were reported as E. coli O157: H7 with PCR assay by using the O-antigen encoding region of O157 gene and flagellar H7 gene (fli C) generic primers as described previously [7, 8].

2.3. Statistical analysis

Data were transferred to a Microsoft Excel spreadsheet (Microsoft Corp., Redmond, WA, USA). Using SPSS 16.0 statistical software (SPSS Inc., Chicago, IL, USA), a Pearson chi-square test and Fisher's exact two-tailed test analysis was performed and differences were considered significant at values of P < 0.05.

3. Results

Table 1 show the prevalence of E. coli O157 and E. coli O157:H7 isolated from beef, camel, sheep, goat and minced beef meat in Isfahan, Shahrekord and Yazd, Iran. In this study, 23 of 484 meat samples (4.7%) were found to be contaminated with E. coli O157. The highest prevalence of E. coli O157 was found in beef minced meat (11.1%), followed by beef meat (8.9%), goat meat (1.7%), and camel meat (1.3%). PCR products are shown in Figs.1 and 2. There were significant differences (P<0.05) in the level of contamination with E. coli O157 between different meat samples; however, no significant differences (P>0.05) were found between lamb meat, goat meat, camel meat and chicken meat. No significant differences in the prevalence rates (P>0.05) were observed between meat samples isolated in Isfahan, Shahr-e Kord and Yazd. The highest prevalence of E. coli O157 occurred in fall (9.1%) followed by spring (5.7%). The prevalence rates of E. coli O157 in summer and winter were 2.5% and 1.6%, respectively.

<table>
<thead>
<tr>
<th>Meat sample</th>
<th>No. of samples</th>
<th>No. (%) of positive E. coli O157:H7 samples</th>
<th>No. (%) of positive E. coli O157:NM samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>90</td>
<td>2 (2.2)</td>
<td>6 (6.7)</td>
</tr>
<tr>
<td>Camel</td>
<td>75</td>
<td>1 (1.3)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Sheep</td>
<td>60</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Goat</td>
<td>60</td>
<td>0 (0.0)</td>
<td>1 (1.7)</td>
</tr>
<tr>
<td>Chicken</td>
<td>82</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
</tr>
<tr>
<td>Beef minced</td>
<td>117</td>
<td>5 (4.3)</td>
<td>8 (6.8)</td>
</tr>
<tr>
<td>Total</td>
<td>484</td>
<td>8 (1.7)</td>
<td>15 (3.1)</td>
</tr>
</tbody>
</table>
4. Discussion

Human infections of *E. coli* O157:H7 have mostly been recognized to be from food products with animal origin [4]. Cattle have been implicated as the principal reservoir of *E. coli* O157:H7 [3]. Many studies determined the prevalence of *E. coli* O157:H7 on cattle carcasses which were from 0.0% to 27.8% (up to 68% in heifers) [1, 3, 4]. The prevalence value reported in the presented in Iran (2.2%) is lower than Netherland (10.4%) [9] and England (13.4%) [3]. Direct comparison of results is difficult due to differences in the study methodologies, such as the type of slaughtering, improved enrichment and isolation procedures, differences in sample size, the type of sample and how and when it was collected [10]. While there is some evidence that *E. coli* O157:H7 may be increasingly common in beef production systems the detection of higher proportions of *E. coli* O157:H7 in more recent studies is more probably associated with the wider use of more sensitive detection methods such as IMS [3].

Of the 117 minced beef samples collected over a 3-year period, a total of 5 (4.3%) were positive for *E. coli* O157:H7. In comparison to other countries, the prevalence reported in this study is higher than in previous studies i.e. 0.17% [11] and 1.4% [12], similar to a Swiss study (2.3%) [13] and lower than reported in a study in Argentina (3.8%) [14].

Due to relative increase in the consumption of camel meat in Iran, we decided to determine the prevalence of *E. coli* O157:H7 in the camel carcasses. The results of this study showed that 1.7% of camel carcasses were positive for *E. coli* O157:H7. The present study demonstrated that the prevalence of *E. coli* O157:H7 was lower than that observed on beef. The study suggests that camel meat may not be a significant source of *E. coli* O157:H7 that have seen in other meat industries but monitoring program and inspection are necessary for preventing outbreaks of food-borne diseases.

The contamination rate of chicken meat samples observed in this study was in agreement with those reported by Jo et al. (2004) in Korea. However, Abdul-Raouf et al. (1996) reported a higher prevalence of *E. coli* O157:H7 in chicken carcasses in Egypt (4.0%) [15]. Also, in a study conducted in Argentina, *E. coli* O157:H7 were isolated from 10.3% of chicken meat samples [14].

The results of this study showed that sheep and goat meat are not an important source for *E. coli* O157:H7 infection. In one study conducted in the Shiraz, Iran, 19 *E. coli* O157:H7 isolates were recovered form 159 sheep meat samples [16]. Similarly, in a study in Ethiopia, Hiko et al. (2008), found a prevalence rate of *E. coli* O157:H7 of 2.5% and 2.0% in sheep and goat meat samples, respectively (17). Also, the prevalence of *E. coli* O157:H7 spp. in retail sheep and goat meat was reported to be 0.77%-7.3% in the Italy (18), 4.0% in Egypt (15), 1.5% in USA (19), 0.5% in Australia (20).

In this study the highest prevalence of *E. coli* O157:H7 was found on meat sampled in fall and spring, which is in agreement with finding of previous studies on beef that reported peak prevalence occurs in early fall (10).
The current study is the first report on the prevalence of *E. coli* O157:H7 on camel and goat carcasses in Iran. Our findings provide some baseline information regarding the prevalence of *E. coli* O157:H7 isolated from animal meat that could be used in future studies. As a result, the most important practice that should be considered in animal slaughtering are cleaning dirty animals before slaughtering, skinning while being on the rail, separating carcasses from each other and avoiding contact between the external surface of the hide and carcasses. Hygiene measures must be sufficient to prevent from contamination via hands, knives, saws, equipments, and clothing.

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6. References


