Presence of Escherichia coli O157:H7 in Ground Beef and Ground Baby Beef Meat

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ABSTRACT

A total of 114 beef and baby beef samples were examined. The samples included ground baby beef, mixed ground baby beef and pork, and chopped and shaped meat. The samples were analyzed from 30 different grocery stores in Zagreb, Croatia. The object of this study was to evaluate the prevalence of Escherichia coli O157:H7 in the samples that can enhance the potential risk of outbreaks of hemorrhagic colitis and hemolytic uremic syndrome. The results in all tested samples of E. coli O157:H7 were negative. A single sample was positive in a latex agglutination test using antiserum to O157:H7. It was identified as Proteus vulgaris at the Pasteur Institute, Paris, France. This result correlates positively with cross-contamination with Yersinia enterocolitica 09, Brucella abortus, Salmonella type N, and Pseudomonas maltophilia.

Escherichia coli is a gram-negative, facultative anaerobe and is considered to be a part of the normal microflora in the intestines in humans as well as in animals. However, some strains can cause diseases in various organic systems. Serotype O157:H7 is a rare type of E. coli linked with the production of one or more toxins known as verotoxin or shiga-like toxin. They are very similar to the toxin produced by Shigella dysenteriae.

Enterohemorrhagic E. coli was identified first as the cause of an outbreak in 1982 of enterohemorrhagic colitis in the United States. It was isolated from frozen beef and from the samples taken from the infected patients (11). E. coli O157:H7 was found in chopped beef that was insufficiently heat-treated so the principal reservoir for this pathogen was beef and, more often, baby beef. E. coli O157:H7 is not a pathogenic microorganism for beef and has been identified in 3.2% of dairy cows and 1.6% of fattened baby cows with the level in feces ranging from 10² to 10⁵ CFU/g. The period of elimination for this pathogen ranges from a few weeks to a few months (14). During treatment in the abattoir, E. coli O157:H7 can be transmitted to carcass surfaces especially during the processes of skinning and evisceration via equipment and hands of the people handling the carcasses (5).

Infection can also be caused by irregular treatment during preparation of foodstuffs. Insufficient heat treatment is an important factor in outbreaks, especially during the processing of ground beef and baby beef dishes. Because the infectious dose is exceptionally low (10 CFU/g) (8) and health problems are serious, proper heat treatment of food to eliminate this pathogen is imperative.

The growth temperature for this pathogen was determined to be in the range of 8 to 45°C, the optimal pH values were 5.5 and 7.5, and the minimal pH value was 4.0 to 4.5. Some strains showed a high acid tolerance (7).

The aim of this study was to determine the level of cleanliness and degree of prevalence of E. coli O157:H7 by controlling handling procedures for ground meat. This study included samples from 20 small meat processing plants.

MATERIALS AND METHODS

Meat samples. Ground beef and baby beef samples were collected in 1998 and in 1999. Roughly equal numbers of samples were examined during all months. Meat samples of an average weight of 500 g were delivered by portable refrigerator early in the morning and were submitted directly to procedures.

Preparation of the samples. Ninety grams of peptone water was added to 10 g of meat sample followed by homogenization in a magnetic mixer (Variomag Electronicührer, Multipoint 15; H+P Labortechnik GmbH Munich, Germany) for 5 min. The sample was incubated for 6 h at 30°C. Ten milliliters of supernatant was transferred to a sterile tube and placed in a centrifuge (Funke Gerber, 0.45 kW/2 A, 60 Hz, 230 V, 4,000 rpm; Germany) for 10 min. The sediment (2 ml volume) was inoculated in Enterobacteriaceae Mossel broth culture (9 ml volume) (Biolife, Italy). The incubation lasted for 16 to 18 h at 37°C. Sample (0.1 ml volume) was transferred by microbiological loop onto McConkey sorbitol methylumbelliferyl-β-glucuronide agar (Biolife) and followed by incubation at 37°C for 24 h.

Identification of the pathogen. Colonies of 1-mm diameter, gray and tiny, methylumbelliferyl-β-glucuronide and sorbitol neg-
ative, were identified as suspicious. A latex test with a Pro-Lab Escherichia coli O157 latex reagent kit was performed (Pro-Lab Diagnostics, Inc., Ontario, Canada). The remaining growing colonies were identified by using a test for the quick identification of enterobacteria (Enterosystem 18R; Liofilchem, Roseto D.A. TE, Italy).

RESULTS AND DISCUSSION

A total of 114 chopped beef and baby beef samples were examined. Thirty-five samples were contaminated by 1 of 8 different microorganisms. Twenty samples (17.55%) were contaminated by Escherichia coli (none of these was enterohemorrhagic E. coli). Only one sample contaminated by E. coli showed positive latex agglutination with antiserum O157. The sample was lyophilized and sent to the Pasteur Institute, Paris (Unité des Enterobactéries) for further identification. Further examination of the sample identified Proteus vulgaris in the sample. The following identified microorganisms were also represented in the following proportions: Proteus mirabilis 4 (3.50%), Enterobacter alvei 4 (3.50%), Enterobacter cloacae 2 (1.75%), Citrobacter freundii 2 (1.75%), Pseudomonas aeruginosa 1 (0.89%), Shigella flexneri 1 (0.89%), and P. vulgaris 1 (0.89%). Percentages refer to the total number of samples. The total proportion of microorganisms in the examined meat samples was 30.70%. One third of the meat samples examined were contaminated by one or more of these enteropathogens (except P. aeruginosa).

In general, the reports conducted in other countries, related to the level of Escherichia coli O157:H7 in meats and meat products are not supported by the results of this study. Data range from 4.6% in Spain (9) (low level of contamination) to 74.5% in Pretoria, South Africa (13) (high level of contamination). None of the isolated pathogens was enterohemorrhagic E. coli. On the other hand, the level of enterohemorrhagic E. coli was in the range of 0.45% in Austria (12), 2.6% in Spain (4), 2.4 and 4.1% in Switzerland (3), 6% in Egypt (1), to 10% in Austria (2). Only one study is confirmed by the present results. Examination of raw, ground beef meat in Italy resulted in a 16.3% level of contamination by some pathogen bacteria, and none of these was enterohemorrhagic E. coli (10).

The United States is considered to be the biggest market threatened by the potential risk of an outbreak. Cases of infection have been reported in more than half of the states with 10,000 to 20,000 people infected each year. A few outbreaks that have appeared since 1982 included some with tragic consequences. Thus, the withdrawal of a large number of beef hamburgers from the market during 1997 and 1998 (which also resulted in great monetary losses) is understandable (6).

Our results are not disturbing. They imply that E. coli modestly contaminates meat samples. The strains identified were not enterohemorrhagic E. coli. The microbiological cleanliness of private meat markets is satisfactory. These results are important because manufacturing treatments and chopped meat are considered to be important factors in the spread of infection (3). Although E. coli O157:H7 has not been identified in this study, to identify the exact serotype of the isolated strains is imperative because of the increased numbers of infections caused by enterohemorrhagic strains of E. coli different from O157:H7. More than 50 different strains of this kind are connected with bloody stool and hemolytic uremic syndrome. The infections are mostly provoked by O26:H11, O103:H2, O111:NM, and O113:H21 (6).

These data show that the results provided by this study should not be neglected. The level of contamination of these foods can be controlled by precise identification of every isolated strain. Preventive measures to stop the spread of infections are required as well. Prevention may include a whole range of measures, from reduction of number of E. coli carriers and reduction of meat contamination during slaughtering and chopping, to proper heat treatment of risky foods at 72°C and hygienic handling of foods. Person-to-person transmission is a possible way of spreading infection, so personal hygiene is especially important. Personal education and responsibility are imperative. These measures present the only way of controlling the presence and harmful influence of E. coli in our environment.

Species of P. vulgaris will be added to the list of microorganisms that cross-react with E. coli O157:H7 serum. The list already includes Yersinia enterocolitica 09, Brucella abortus, Salmonella type N, and Pseudomonas maltophilia.

REFERENCES


