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Escherichia coli 0517:H7: An emerging bacterial zoonotic food borne pathogen of global significance

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Abstract

In recent years, *Escherichia coli* 0157: H7, a Gram negative bacterium, has emerged as an important global zoonotic food borne pathogen, which produces serious illness in humans such as haemorrhagic colitis, haemolytic uraemic syndrome (HUS) and thrombotic thrombocytopenic purpura (TTP). The patient who develops TTP carries a fatality rate of 50 %, and death in HUS is due to renal failure. Cattle are considered as the primary reservoir of this pathogen. Faecal-oral- route is the chief mode of transmission. Humans may acquire infection by the ingestion of raw ground beef, other animal products and contaminated fruits and vegetables, direct contact with animal carriers, their faeces and contaminated soil or water. The raw or undercooked ground beef is implicated in several outbreaks of disease. The infection can result in life threatening complications in young children, elderly persons, and immunocompromised patients. Microbiological and molecular techniques are employed for the isolation and characterization of *Escherichia coli* o157:H7. Sanitary operations in abattoirs, good personal hygiene, proper disposal of faeces, use of chlorinated water, ingestion of pasteurized milk, thorough washing of fruits and vegetables, and public education about the consumption of cooked meat will certainly help to reduce the incidence of this emerging pathogen which pose a global threat to public health. It is emphasized to undertake further studies on the faecal carriage of other food animals, risk factors, host agent interaction, and simple and cheap diagnostic test for this emerging food borne zoonotic pathogen.

Key words: Abattoir sanitation, Beef, Emerging food borne pathogen, *Escherichia coli* 0157:H7, Faecal -oral- route, Public health, Transmission

Introduction

Escherichia coli 0157: H7 is an emerging food borne bacterial zoonotic pathogen that causes diarrhoea, haemorrhagic colitis and haemolytic uraemic syndrome in humans worldwide (Doyle, 1991; Armstrong *et al.*, 1996). It was first recognized as a food borne pathogen as a result of an outbreak of an unusual gastrointestinal illness in 1982, and the organism was isolated from haemorrhagic colitis patients who had eaten undercooked patties (Riley *et al.*, 1983). In USA 10,000 to 20, 000 human cases and 500 deaths are reported each year (Read and Kaplan, 1996). Recently, a number of outbreaks have occurred in children visiting farms and petting zoos where they come in contact with animals carrying *E.coli* 0157:H7 and their environment (Grif *et al.*, 2005). The pathogen causes life threatening infection in patients who are compromised due to AIDS or cancer. The infection primarily occurs through faecal-oral-route. *E. coli* 0157: H7 is responsible for 20% of food borne outbreaks. The cost of *E.coli* 0157: H7 to the food industry as a result of destroyed foods, recalls, control measures and lost demand associated to lack of consumer confidence is estimated to be in the billions of dollars in the United States alone (Frenzen and Drake, 2005). The organism is found in the intestines of healthy cattle, sheep, goats and deer. A plethora of foods such as beef, milk, cheese, curd, fruits, vegetables, juice, etc. serve as vehicle for *E.coli* 0157:H7 (Ach and Szyfres, 2001; Davies *et al.*, 2005; Vijayrani *et al.*, 2010). The infectious dose is very low that increases the risk of disease (Feng, 1995; Armstrong *et al.*, 1996). The present communication delimitates the growing role of *E.coli* 0157: H7 as an emerging food-borne zoonotic pathogen of global significance.

Etiology

The infection is caused by *E.coli* 0157: H7, which belongs to the genus *Escherichia* and family *Enterobacteriaceae*. The organism is Gram negative, rod shaped, motile, catalase positive, indole positive, MR positive, oxidase negative, urease

negative, Voges Proskauer negative, and citrate negative. It produces pink, flat low convex colonies on Mc Conkey agar. Green metallic sheen colonies are observed on eosin methylene blue (EMB) medium. On Mc Conkey sorbitol agar, colourless colonies grows. The organism shows resistance to a number of antibiotics such as ampicillin, amoxicillin, ceftriaxone, chloramphenicol, ciprofloxacin, cotrimoxazole, methicillin, tetracycline and vancomycin (Zadic *et al.*,1993; Su and Brandt,1995; Vijayrani *et al.*,2010; Naik and Desai, 2012). The bacterium is widely distributed in the soil, water, vegetation, decaying matter besides large intestine of most animals (Davis *et al.*, 2005).

Host

Infection due to *E.coli* 0157:H7 has been recorded in humans from several countries of the world. The pathogen has been isolated from the faeces of cattle, goats, sheep, deer, elk, horses, dogs, poultry, raccoons, opossums, ostriches, emus, doves, pigeons and canary (Bentin *et al.*, 1996; Acha and Szyfres,2001; CFSPH,2009).

Transmission

Faecal – oral- route is the principal mode of transmission. Human are infected after consuming food or water that has been contaminated with faeces containing *E.coli* 0157: H7. Contact with animals, faeces and contaminated soil can also transmit infection to humans (CFSPH, 2009). Beef may become contaminated during slaughter, and the process of grinding beef may transfer pathogens from the surface of the meat to the interior. If ground beef is then inadequately cooked, the bacteria can survive and be ingested. The organism also spread from one food item to another by hands, cooking utensils, cutting boards and unclean food preparation surfaces. Ingestion of contaminated fruits, vegetables, milk, yoghurt, and water can also cause infection (Upton and Coia, 1994; Park *et al.*,1999; Calmers *et al.*,2000; CFSPH,2009).

Clinical spectrum

The incubation period of disease is 1 to 6 days. Most infections become apparent after 3-4 days. The affected persons exhibit the signs of water diarrhea, hemorrhagic colits, abdominal tenderness, severe abdominal cramps, low grade fever, nausea, vomiting, dehydration, hemolytic anemia and kidney failure. Other sings include irritability, lethargies, seizures, paresis, stroke, cerebral oedema, pleural effusion, and respiratory distress. The infection is severe in children, elderly, pregnant women and immune compromised parsons (Karch *et al.*,2005; CFSPH,2009).

Epidemiology

In recent past, many emerging zoonotic agents have been reported from several regions of the world (Pal, 2013). Among these, *E.coli* 0157:H7 is one of the most important food borne zoonotic pathogen, which causes significant morbidity and mortality in developed and under developing nations (Park *et al.*,1999,Acha and Szyfres,2001; CFSPH,2009). Though cattle serve as the most important reservoir for *E. coli* 0157: H7, the role of other ruminants are also described (Bentin *et al.*, 1996; Pepin *et al.*,1997; Acha and Szyfres,2001).The ingestion of undercooked ground beef, other meats and sausages, unpasteurized milk and cheese, contaminated radish sprouts, fruit juices, salad greens and melon resulted into an outbreak of *E.coli* 0157:H7 infection (Upton and Coia,1994;WHO,1996;Acha and Szyfres,2001). Swimming in contaminated water, especially the streams and lakes are also implicated with infections (CFSPH, 2009). The hemolytic uremic syndrome (HUS) occurs in up to 16% of patients with hemorrhagic colitis (Karch *et al.*,2005). In the elderly patients, the case fatality rate for HSU may reach up to 50%. Contaminated water used for irrigation or washing of vegetables can be the source of infection for humans (Paton and Paton, 1998). The foods can be contaminated with *E.coli* 0157:H7 by cross contamination during food preparation, and by infected workers who do not practice good hygiene. Outbreaks of *E. coli* 0157:H7 due to contaminated dairy products are usually associated with unpasteurized milk but there have been some cases of post-pasteurization contamination. The organism is distributed globally in the soil, water, vegetation, decaying matter, and the intestine of most animals(Ach and Szyfres,2001). It can enter the food chain via faecal contamination of milk, contamination of meat with intestinal contents during slaughter or contamination of fruits and vegetables with contaminated manure. Moreover, contaminating water used for irrigation or washing of vegetables can also be the source of infection for humans and animals. *E.coli* 0157: H7 is an emerging food borne pathogen, which is a major cause of bloody and non-bloody diarrhea in many countries of the world (Paton and Paton,1998).

Diagnosis

The isolation of the pathogen from food or stool specimens involves first enrichment in a selective broth and then plating on to cefixime tellurite sorbitol Mc Conkey agar (CT-SMAC). On this medium, slightly transparent, almost colourless colonies

with a week pale brownish appearance having a diameter of 1 mm (Su and Brandt,1995; Naik and Desai,2012).Such presumptive colonies should be subcultured on to nutrient agar for biochemical tests. Other methods such as multilocus enzyme electrophoresis, plasmid profile analysis, pulse field gel electrophoresis may further differentiate the organism. PCR can be used to detect the bacteria in environmental samples. Direct immunofluorescence (DIF) is helpful to demonstrate the pathogen in human faeces (Park *et al.*,1999; Klerks *et al.*,2004; CFSPH,2009).

Treatment

The role of antibiotics is controversial and usually be avoided. However, the patients with complications may require intensive care including dialysis, transfusion and/ or platelet infusion besides kidney transplant (Su and Brabdt,1995; Acha and Szyfres 2001; CFSPH,2009).

Prevention and Control

Thorough cooking of ground beef and other meats, pasteurization of milk and apple juice, proper washing of fruits and vegetables, careful hand washing after handling the animals and changing diapers, avoiding the use of fresh manures from ruminants in the field, keeping livestock away from water supplies, proper disposal of infected faeces, good kitchen hygiene practices, and personal hygiene will be useful to minimize the incidence of *E. coli* 0157: H7 infection (WHO,1996; Acha and Szyfres,2001; CFSPH,2009).

Conclusion

Despite a great scientific progress and technological developments, the microbial food borne infections still remain a major public health concern throughout the world. *E.coli* 0157: 47 is an emerging bacterial food borne pathogen that causes serious illness in humans. Ground beef continues to be an important food borne vehicle of transmission of outbreaks. Person to person transmission can contribute to disease spread during outbreaks. It can cause life threatening infection in the immune compromised patients particularly AIDS. Good hygiene, careful hand washing and proper disposal of faces can prevent the spread of infection. All the abattoirs must adopt HACCP at every stage of beef supply chain. It is emphasized that all bloody stools in early period of illness should be investigated particularly for *E.coli* 0157:H7.

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