Meat-Associated Pathogens of Recent Concern

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Within the past decade, several bacterial pathogens have emerged as newly recognized or important agents of foodborn disease. Many of these pathogens are associated with animals that are sources of meat for human consumption. They include *Campylobacter jejuni, Yersinia enterocolitica, Escherichia coli* 0157:H7, and *Listeria monocytogenes* (Doyle, 1985).

Campylobacter jejuni

At one time only recognized as a pathogen of animals, *C. jejuni* is now known as a leading cause of acute bacterial gastroenteritis in humans throughout the world. A recent study in the United States revealed that *C. jejuni* was isolated from fecal specimens of patients more often than *Salmonella* and *Shigella* combined. Foods of animal origin are a source of many campylobacter infections, with raw milk, undercooked poultry and raw hamburger being implicated as vehicles of transmission in outbreaks of campylobacter enteritis.

C. jejuni is a common part of the intestinal flora of many mammalian and avian species, having been isolated from feces of healthy cattle, swine, sheep, goats and poultry. Often, greater than 10^6 *C. jejuni* are present per gram of animal feces. Surveys of retail meats indicate *C. jejuni* is present in about 3.5% to 8% of red meat and 30% to 85% of poultry meat.

Interestingly, *C. jejuni* does not survive well outside of its host's environment nor is the organism likely to grow well in foods. However, studies done to determine infectious dose revealed that ingestion of relatively small numbers (a few hundred cells) of *C. jejuni* can produce illness. The organism's apparent high degree of virulence and its widespread prevalence in animal-derived foods are important factors in explaining why this sensitive bacterium is a leading cause of human enteric infections.

Yersinia enterocolitica

Yersinia enterocolitica is not a prevalent cause of human illness in the United States; however, within the past decade the organism was responsible for several significant outbreaks of foodborne disease. Illness occurs primarily in infants and young children and is often manifested by severe abdominal pain in the right lower quadrant, which is suggestive of acute appendicitis and often leads to surgery.

The organism is often present in the environment and the alimentary tract of animals, but most isolates are types not associated with human infection. The exception is isolates obtained from swine. Serotypes of *Y. enterocolitica* commonly associated with human infection have been isolated from the tongue, throat and feces of healthy pigs, hence swine are thought to be a primary reservoir of pathogenic *Y. enterocolitica* and many investigators believe that pigs play a major role in the epidemiology of human infection.

Escherichia coli 0157:H7

Escherichia coli 0157:H7 was clearly recognized as a human pathogen in 1982 when the organism was identified as the cause of two food-associated outbreaks of an unusual gastrointestinal illness. Both outbreaks were epidemiologically linked to eating ground beef sandwiches, and *E. coli* 0157:H7 was isolated from a raw ground beef patty from the same lot as that used at one of the restaurants implicated in an outbreak. More recently, we have isolated this type of *E. coli* from retail ground beef, pork chops and chicken legs.

The symptoms of *E. coli* 0157:H7 infection can often be quite severe, typically beginning with the sudden onset of severe abdominal cramps which are followed by frank blood in the stools. The illness has been termed hemorrhagic colitis. In some instances, the illness may progress to hemolytic uremic syndrome, which is a leading cause of renal failure in childhood and occasionally results in death.

Listeria monocytogenes

Listeria monocytogenes has recenty received interest as a foodborne pathogen following three food-associated outbreaks of listeriosis which resulted in many deaths. One outbreak was linked to consumption of coleslaw prepared from cabbage grown in fields fertilized with manure from a flock of sheep that had cases of ovine listeriosis. The other two outbreaks were dairy-related, with pasteurized milk and Mexican-style cheese identified as the vehicles of transmission.

Listeric infections primarily occur in certain high-risk populations, including infants, pregnant women and immunosuppressed individuals who have an underlying illness. Clinical manifestations of listeriosis are primarily perinatal septicemia, meningitis and abortion. Newborns constitute the largest single group of identified infections. Typically, the mortality rate for listeriosis is about 30%, with mortality occurring most frequently among newborns and patients over 70 years of age.

Many humans and animals, including cattle, swine, poultry, and sheep, are healthy intestinal carriers of *L. monocytogenes*. Reports indicate a greater than 10% incidence of

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fecal carriers among healthy cattle. Results of at least one survey indicate the isolation of *L. monocytogenes* from retail poultry carcasses. Hence, the organism is also likely to be associated with red meats.

Concluding Remarks

It is estimated that at least 24 million food-associated cases of diarrheal disease occur annually in the United States (Archer and Kuenberg, 1985). Animals used for the production of meat are a principal source of many of the bacterial pathogens involved in outbreaks of foodborne disease. Continuing research efforts are needed to define means by which these pathogens colonize animals so that means may be developed to reduce the prevalence of harmful bacteria in animals used for meat. As long as there is little effort to reduce the prevalence of human enteric pathogens in animals used for food, we likely will continue to experience large numbers of food-associated cases of gastroenteritis.

References

Archer, D.L.; Kvenberg, J.E. 1985. Incidence and cost of foodborne diarrheal disease in the United States. J. Food Prot. 48:887-894.

Doyle, M.P. 1985. Food-borne pathogens of recent concern. Annu. Rev. Nutr. 5:25-41.

Discussion

A. Kotula, USDA: Can you give us some relationships between virulence and the isolations from fecal samples for yersenia or from fecal samples for yersenia or campylobacter or aeromonas or any others?

M. Doyle: I cannot comment on the relationship of those isolates from fecal specimens that are virulent versus avirulent. The reason I say that is because we really don't have methods to differentiate virulent strains from avirulent strains. I think that the best methods we do have are for yersenia, and those are not all that definitive. We are learning a lot about aeromonas; in fact, there still has not been a true foodborne outbreak linked to aeromonas. That's why I did not report on that organism here. Regarding campylobacter, we are continuing to learn more and more about the organism. It has been shown to produce certain toxins and to be invasive. Perhaps there are many different mechanisms of pathogeneity which we still need to define further before we can say that we have different virulent factors and can use these tests to say that this organism is indeed pathogenic.