UNDER THE MICROSCOPE:

INCIDENCE OF O157:H7 AND OTHER ENTEROHEMORRHAGIC *ESCHERICHIA COLI* IN FARM ANIMALS

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Dr. John M. Fairbrother graduated in 1972 with a BSc. In Veterinary Science from the University of Sydney (Australia). He was a veterinary practitioner in Australia, for five years before embarking on a doctoral program in veterinary bacteriology at the Cornell University (New York) in 1977. In 1981, he joined the Department of Pathology and Microbiology at the Faculté de médecine vétérinaire, University of Montreal, to carry out research on porcine colibacillosis. In 1985, he joined the Research Group on Swine Infectious Diseases (GREMIP) at the veterinary faculty, as a research scientist and was director of GREMIP from 1992 to 1996. From 1995, he has been a full professor at the University of Montreal. At present, his research program focusses on the characterization of virulence factors of *E. coli* pathogenic for pigs and poultry; on the determination of the role of these factors in the host-parasite interaction in *in vivo* and *in vitro* models; on the detection and determination of the prevalence of pathogenic *E. coli* producing these factors; and on development of vaccines for colibacillosis.

For the last 12 years, Professor Fairbrother has also supervised The *Escherichia coli* typing laboratory of the Diagnostic Service of the FMV. He was a member of the Grant Selection Committee for Animal Biology, Natural Sciences and Engineering Research Council of Canada from 1996 to 1999, and is currently a member of the Scientific Advisory Board of the Canadian Bacterial Disease Network.

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Escherichia coli are bacteria found in large numbers in the intestinal tract of all animals. Most *E. coli* are harmless commensals. However, certain strains produce virulence factors that allow them to cause a variety of diseases. One group of such strains, called enterohemorrhagic *E. coli* or EHEC, produce a family of very powerful toxins which affect animal cells. These strains are associated with outbreaks of hemorrhagic colitis, often manifesting as bloody diarrhea, and haemolytic uremic syndrome in humans. A consensus on the nomenclature for this group of strains has not yet been reached, a situation which may be confusing for the novice. For instance, the family of toxins produced by these strains are known by two different names, the verotoxins and shiga-like toxins, and hence this group of *E. coli* may also be referred to as the verotoxinogenic *E. coli* (VTEC) or Shiga-like toxin *E. coli* (STEC). Most, but not all, enterohemorraghic *E. coli* strains can attach tightly to the intestinal wall by means of a group of proteins including an adherence factor called intimin.

Before the virulence factors of these *E. coli* were well characterized, enterohemorraghic *E. coli* were identified by serotyping, based on the type of O or bacterial surface antigens and the H antigens which are involved in bacterial motility. This permits an initial grouping of similar or identical strains. The best known and most commonly encountered serotype of this group of strains is O157:H7. Selective culture media, enrichment techniques, and magnetic bead separation have provided a rapid and fairly sensitive means for the detection of

O157:H7 *E. coli*. However, enterohemorraghic *E. coli* of other serotypes such as O26:H11 and O111:NM have also been associated with disease in humans. Thus, use of methods for the detection of O157:H7 but not of other enterohemorrhagic *E. coli* may result in a biased perception of the importance of this serotype in disease. Much more information is available on the incidence of O157:H7 in farm animals and their products than on the incidence of the other serotypes. The use of cell culture techniques led to the development of highly sensitive assays for the detection of the toxins of enterohemorrhagic *E. coli* in feces, meat and other samples and permitted a more accurate assessment of the incidence of these bacteria in animals and their products. More recently, highly specific and sensitive genetic assays have been used to detect the virulence genes of enterohemorraghic *E. coli.* These assays are based primarily on the detection of the genes for the toxin but may also detect strains positive for the intimin and other virulence factors, thus allowing a more precise identification of the strains. Standardized, highly discriminatory DNA fingerprinting techniques are being developed to compare foodborn bacteria, particularly O157:H7 *E. coli* strains. Researchers and public health laboratories are now using these techniques to more efficiently identify and control the source of O157:H7 and other enterohemorraghic *E. coli* infections in humans and to evaluate the public health risk associated with the presence of enterohemorraghic *E. coli* in farm animals and their meat products.

Enterohemorraghic *E. coli* are carried by a high proportion of healthy cattle, both calves and adults. These include a range of serotypes such as O157:H7, O26:H11, O103:H2 and O11:H-. Some of these strains may cause disease in calves as a result of management problems or in humans, whereas others, such as O157:H7, only cause disease in humans. Less information is available on the incidence of enterohemorraghic *E. coli* in small ruminants. O157:H7 enterohemorraghic *E. coli* have recently been found in the feces of sheep and goats, demonstrating that these species may also be a source of contamination for humans. Other serotypes of enterohemorraghic *E. coli* have also been detected in sheep and goat flocks, the proportion of positive animals being very high in some flocks. O157:H7 enterohemorraghic *E. coli* have also been found in farmed and wild deer and various serotypes have been observed in buffalo calves. In general, pigs and pork products are not considered as a source of contamination with enterohemorraghic *E. coli* for humans. Most verotoxin-producing *E. coli* found in pigs are associated with an edema disease in that species and not with disease in humans. There have only been a few reports of isolation of O157:H7 enterohemorraghic *E. coli* from pigs, and not as yet in North America. Enterohemorraghic *E. coli*, including O157:H7, have been isolated occasionally from the feces of chickens and turkeys, demonstrating that poultry may also be a source of infection for humans.

Various strategies for decreasing the risk of foodborn illness in humans due to enterohemorraghic *E. coli* are presently being considered. These strategies are aimed at decreasing fecal shedding of O157:H7 and other enterohemorraghic *E. coli* in cattle prior to slaughter and hence at reducing carcass contamination by these bacteria. They include manipulation of cattle feeding practices, for example feeding of hay or brief starvation, vaccination, and phage treatment. Use of such strategies, together with good food safety practices, may result in a decreased incidence of outbreaks of hemorrhagic colitis in humans.