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# Livestock Pathogens and Food Safety: A Growing Public Health Challenge

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## Key Points

- Food-borne pathogens such as *Salmonella*, *Campylobacter*, *Escherichia coli*, and *Listeria monocytogenes* are important zoonotic agents that affect both livestock health and human food safety.
- Contaminated feed, water, poor farm hygiene, and improper processing facilitate the transmission of these pathogens, leading to reduced animal productivity, economic losses, and food-borne illnesses.
- Good farm hygiene, biosecurity, cold-chain management, prevention of cross-contamination, and responsible antibiotic use are essential for controlling food-borne pathogens and ensuring safe animal-derived foods.

***Abstract***

Food-borne diseases are major public health concerns caused by the consumption of contaminated food and beverages. Various bacterial and parasitic pathogens are involved in these infections, many of which possess zoonotic significance and toxin-producing ability. Food-borne diseases, commonly referred to as food poisoning or food-borne illnesses, Important bacterial pathogens include *Salmonella*, *Campylobacter*, *Escherichia coli*, *Listeria monocytogenes*, and *Clostridium* species, while parasitic organisms such as *Taenia* spp., *Toxoplasma gondii*, and *Cryptosporidium parvum* are also responsible for food-borne transmission.

**Keywords:** Food-borne pathogens, Livestock, Zoonotic pathogens, Food safety, Salmonella, Campylobacter.

## Introduction

Food-borne diseases represent one of the most important public health challenges worldwide and are responsible for considerable morbidity, mortality, and economic losses each year. These diseases arise primarily through the consumption of food contaminated with

pathogenic microorganisms, toxins, or harmful chemical substances. Among the various sources of contamination, livestock animals play a significant role as reservoirs and carriers of numerous food-borne pathogens. Cattle, buffaloes, sheep, goats, pigs, and poultry are commonly associated with the transmission of bacterial, viral, and parasitic pathogens that can enter the human food chain through meat, milk, eggs, and other animal-derived products (Jay *et al*., 2005). Foodborne pathogens are responsible for millions of sporadic infections and large-scale disease outbreaks in animal populations worldwide. Livestock and poultry are particularly susceptible to enteric infections caused by contaminated feed, water, and poor hygienic management practices. Young animals, especially neonates and weaners, are highly vulnerable because of their immature immune systems. Several reports have indicated that enteropathogenic microorganisms play a significant role in gastrointestinal diseases of food-producing animals, resulting in high morbidity and mortality, reduced productivity, poor growth performance, and major economic losses to the livestock sector (Mead *et al.*, 1999). Important pathogens such as *Salmonella*, *Escherichia coli*, *Campylobacter*, *Clostridium perfringens*, and *Listeria monocytogenes* are among the major causes of foodborne and zoonotic infections in animals. Furthermore, studies have estimated that bacterial foodborne pathogens account for a substantial number of illnesses and deaths in livestock and poultry every year, although the actual burden is considered much higher due to underreporting and lack of proper disease surveillance systems. Therefore, foodborne diseases continue to pose a serious threat to animal health, food safety, and global livestock production systems (Newell *et al.*, 2010).

**Salmonella**

Salmonella recognized as a significant public health concern affecting humans as well as a wide range of warm-blooded animals. Wild avian species play a dual role in the epidemiology of this pathogen, functioning both as carriers capable of transmitting infection and as susceptible hosts for certain host-adapted strains. Earlier investigations suggested that wild birds were a major source of *Salmonella* transmission to livestock populations (Majowicz *et al.* 2010). These microorganisms can be transmitted vertically from infected parent stock or acquired horizontally from contaminated surroundings such as feed, water, litter, and farm equipment. Among them, Salmonella species are considered major pathogens responsible for salmonellosis and several related infections in poultry as well as humans. Salmonellosis is recognized as one of the leading food-borne zoonotic diseases across the globe, posing a serious threat to public health and the poultry industry. It has been estimated that *Salmonella* infections contribute to nearly 93.8 million cases of food-borne illness and approximately 155,000 deaths annually worldwide. In the United States alone, more than one million human cases of

salmonellosis are reported every year, highlighting the widespread occurrence and public health significance of this pathogen (Barrow *et al.* 2011).

**Campylobacter**

Foodborne diseases caused by bacterial pathogens continue to pose a serious threat not only to human health but also to animal health and livestock productivity worldwide. Among these pathogens, Campylobacter species are recognized as important agents responsible for enteric infections in a wide variety of domestic and wild animals. In poultry, cattle, sheep, pigs, dogs, and other farm animals, Campylobacter infection is associated with intestinal disorders, reduced growth performance, poor feed efficiency, reproductive problems, and economic losses to the livestock industry. Young and immunologically weak animals are particularly more susceptible to infection, and in severe cases the disease may lead to dehydration, weakness, and mortality. In intensive farming systems, the spread of Campylobacter occurs rapidly through contaminated feed, drinking water, litter, fecal material, and poor hygienic management practices (Sahin *et al.*, 2015). The significance of Campylobacter infection in veterinary science has increased considerably because animals act as the principal reservoir of these bacteria (Kaakoush *et al*., 2015).

**Shiga toxin-producing *E. coli* (STEC)**

Escherichia coli Infection associated bacteria, commonly known as *E. coli*, is regarded as one of the most extensively investigated microorganisms in the fields of microbiology and molecular genetics. This bacterium normally exists as a natural inhabitant of the intestinal tract and forms part of the normal gut microflora in both humans and animals. It is among the earliest microbial populations that establish themselves in the gastrointestinal system shortly after birth, thereby contributing to the development of intestinal balance and host immunity (Madigan *et al.*, 2018).

**Listeria**

Listeriosis is an important zoonotic disease caused mainly by *Listeria monocytogenes*, a facultative intracellular bacterium widely distributed in nature. This microorganism is commonly found in soil, water, decaying vegetation, animal feces, and food-processing environments, demonstrating its remarkable ability to survive under adverse environmental conditions. Unlike many other bacterial pathogens, *L. monocytogenes* can tolerate refrigeration temperatures, high salt concentrations, acidic environments, and other stress factors, which enables its persistence in a wide variety of food products and processing facilities (Farber and Peterkin, 1991). Owing to these adaptive characteristics, the organism has emerged as a major concern for public health as well as food safety industries worldwide. The genus Listeria presently comprises more than twenty identified species of small, rod-shaped, gram-positive

bacteria that are broadly distributed in the environment. Among these species, Listeria monocytogenes is regarded as the principal pathogen affecting both humans and animals, whereas, *Listeria ivanovii* mainly causes infections in animals, particularly sheep and cattle (Swaminathan and Gerner-Smidt, 2007).

**Prevention and control measures**

The following preventive measures are considered essential for reducing the public health risks associated with food-borne enteropathogens:

- Maintaining strict sanitary conditions on farms and isolating infected or diseased animals from healthy stock can substantially lower the microbial load and reduce disease transmission among animals.
- Since low temperatures inhibit or destroy many enteric pathogens, proper chilling and cold-chain management after slaughter are crucial to ensure microbial safety of meat and other animal products.
- Cross-contamination between contaminated and uncontaminated materials should be strictly prevented during slaughtering, processing, packaging, and storage operations through hygienic handling practices.
- Biosecurity and surveillance measures must be regularly implemented in farms and food-processing environments to restrict the spread of pathogenic microorganisms.
- Antibiotics should be administered responsibly and only when necessary for animal treatment, as indiscriminate use may contribute to the development of antimicrobial resistance.

**Conclusion**

Foodborne pathogens represent a major concern for both animal health and public health worldwide. These harmful microorganisms can infect a wide variety of animals and may subsequently enter the human food chain through contaminated meat, milk, eggs, or other animal-derived products. In animals, such pathogens can lead to reduced productivity, poor growth performance, reproductive disorders, and increased mortality, thereby causing significant economic losses to the livestock sector. Hence, effective disease prevention and control measures are essential to limit the transmission of pathogens throughout animal production and processing.

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