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Food-borne Pathogens: A Brief View

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Abstract

The human civilization is faced with a formidable task to feed, house and ensure a healthy lifestyle for the continuous expanding human population, all the while protecting the environment and natural resources for the benefit of coming future generations. Food-borne zoonotic infections are the primary global cause of disease in humans and they are particularly prevalent in underdeveloped nations where they inflict significant economic losses in addition to public health problems. *Salmonella* species, *E. coli, L. monocytogenes, S. aureus*, and *Campylobacter* species are the world's most common zoonotic bacterial infections, responsible for foodborne illnesses and deaths linked to the consumption of tainted animal products. Food safety management systems provide a better option to produce safe food for human consumption.

Key words: Food-borne, Food safety, Zoonosis, Animal products

Introduction

Demand of animal-based products is continuously increasing proportionately with that of human population, urbanization and altered consumer habits. Since there are numerous agents causing severe illness in animals, probability of their transfer from animal to human also exists in animal-based food production chain. Foodborne pathogens are biological causative agents of ailments in human body. Global concern rising regarding zoonotic potential and toxin producing ability of pathogens in animal-food derived products. Foodborne diseases are faced in form of sporadic, chronic and outbreaks in- and between countries due to compromised food safety practices. Intensive animal production system, mass movement of products across boundaries of different countries and defective processing practices together contributes to enhanced risk of transmission of pathogens from farm to fork supply chain. Several factors are critical regarding contamination, involving from environment surrounding animal to human handling procedures.

As per World Health Organization (WHO), foodborne diseases are illnesses of an infectious nature brought on by consuming contaminated food or water. There are three modes of food-borne diseases namely, intoxication, infection and toxico-infection. Humans can compromise to animal-borne diseases either by consuming them or coming into direct contact with them, or by indirect environmental interaction. Animal-derived food products are thought to be one of the major sources of food-borne illnesses and animals such as cattle, pigs, poultry, turkey, etc. serve as primary reservoirs for numerous

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food-borne diseases. Zoonotic transmission related to meat, milk, egg, fish, etc. is on continuous rise due to elevated consumption of animal origin food and by-products. Food-borne illnesses are serious health issues that affect both developed and developing nations, yet the majority of the burden of food-borne illnesses typically falls on poor nations.

Major food-borne pathogens

1. *Staphylococcus aureus*

After salmonellosis, which is the most frequent food-borne infection in the world, staphylococcal infections show highest number of incidences. It is a microbe that healthy humans and animals have commensally on their skin, noses, and mucous membranes. It is a well-known opportunistic food-borne pathogen, nonetheless and it can cause a variety of infectious disorders with different levels of severity in both humans as well as animals. Improper antibiotic usage and bacteria's quick development and acquisition of resistance to medicines have led to the creation of resistant strains, including methicillin-resistant *S. aureus* (MRSA). There is significant concern over the spread of MRSA in cattle and the potential for human cross-contamination. *S. aureus* contamination might come directly from infected food-producing animals, practicing unhygienic manufacturing procedures, or from food material being sold and stored improperly.

Several dietary items are commonly linked to Staphylococcal food poisoning which includes milk and dairy products, meat of pig, cattle, mutton, poultry and eggs also. Pathogenicity is attributed to numerous factors including coagulase, enterotoxins, hemolysins, toxic shock syndrome toxins, etc. Bacteria can cause a wide range of illnesses with diverse symptoms, from treatable skin infections to more severe conditions that can be fatal, like necrotizing fasciitis, septicemia, infective endocarditis and necrotizing pneumonia. Staphylococcal infections can be avoided by properly cooking of food, avoiding contamination and cross-contamination and maintaining critical points. Educating the public about safe meat handling practices and other public health initiatives could be crucial in preventing the outbreak cases.

2. *Salmonella*

It is the primal cause of food poisoning worldwide compromising human and animal health. *Salmonella enterica* and *Salmonella bongori* are the two main species of the bacterium. It is the primary source of food-borne illnesses and a significant global public health issue with raising concerns about the emergence of new resistant species. In addition to the expenses associated with human and animal disease and mortality, trade limitations and the need to dispose affected food are also significant socioeconomic issues observed worldwide. It is common habitant of digestive tract of animals, humans, birds and insects and also found in natural environment.

Outbreaks of salmonellosis in humans has been linked to a number of causative factors, including the consumption of raw or contaminated food, cross-contamination, inadequate food storage facilities, poor personal hygiene, improper cooling and reheating of food items and a prolonged period of time between food preparation and consumption. The prominent causes of *Salmonella typhimurium* infections have been identified as undercooked pork, ground beef, dairy products, and particularly raw eggs. Besides

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the food borne transmission, other modes of transmission include ingestion of contaminated water, animal derived food products and contact with contaminated food handling and processing equipment. Several virulence factors aid in the establishment of the pathogen inside animal or human body and contributes to its pathogenicity. Affected individuals manifest symptom like gastroenteritis, severe diarrhea, emesis and signs of septicemia at later stages. Prevention of secondary contamination by adopting cleaning and disinfection practices along with prudent cooking, proper pasteurization of food, adequate storage and prohibiting animals to reach food-handling portions, can help to minimize chances of infections.

3. *Listeria monocytogenes*

This bacterium is one of the causes of multiple foodborne illness outbreaks occurring across the world. Even though *L. monocytogenes* very occasionally causes disease, it is a major source of foodborne deaths, which has a significant financial impact on both society and the food industry. *L. monocytogenes* is inhabitant of plant, soil, and surface water samples and also detected in sewage, slaughterhouse waste, silage, milk from healthy and mastitis-affected cattle and human and animal voided excreta. In high-risk populations, it can result in serious, perhaps fatal diseases manifested as meningitis, meningo-encephalitis, sepsis, spontaneous miscarriage, stillbirth ant fetal infection.

Maintaining elite standard clean practices for surfaces coming into contact with food can help prevent listeriosis. Appropriate implementation of food safety standards is necessary to reduce listeriosis related infections and adoption of good hygiene, GMP and sanitation in operational procedures are the most appropriate solutions.

4. *Campylobacter*

This bacterium causes numerous cases of human and animal diarrhea throughout the world and imposes problematic situation in both developing and industrialized countries across the world. They are ubiquitous in nature and found to be present in many reservoir hosts like poultry, cattle, wild animals, birds, dogs and cats. Although they directly do not result in considerable mortality but significantly contributes to secondary infections and leading to complication of diseased cases.

Direct contact with affected animals, contaminated water sources, equipment and carcass are the major routes of transmission of the pathogen. Particularly the consumption of infected poultry meat and its products serves as the important cause of transmission. The symptoms of campylobacteriosis in humans include vomiting, fever, cramps, diarrhea that is either bloody or watery and stomach cramps. It is particularly fatal for young children because they are more likely to experience dehydration and lose essential nutrients due to frequent diarrheal condition. Strict sanitary measures, hygiene practices, biosecurity implementation, and personnel sanitation are some of the critical ways to address and reduce the chances of campylobacter associated disease conditions.

5. *E. coli*

This organism being universal in environment can easily get access to food chain production and considered as reliable index of fecal contamination of food and water. It is generally found in lower gut of all humans and animals as non-harmful organism, while some of its strains which harbors virulence factors are pathogenic in nature and causes severe disease. Contact with contaminated food and water regarded

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as the most potent pathway for its transmission. Consumption of raw meat, unpasteurized milk and milk products, cross contamination of carcass in slaughter house during processing are the potent ways for its dissemination.

Production of Shiga like toxins, adherence factors and enterotoxins lends to its pathogenicity and aids in colonization and proliferation inside animal/ human body. Onset of hemorrhagic colitis, thrombotic thrombocytopenic purpura, hemolytic uremic syndrome with abrupt renal failure, diarrhea, stomach discomfort and vomiting manifests as clinical symptoms in compromised individual. The same strategies that work to prevent other bacterial foodborne illnesses can also be employed to prevent *E. coli* related foodborne illnesses like proper sanitation, prevention of contamination of food, strict adherence to GMP and hygienic conditions.

Besides aforementioned pathogens, some important food-borne disease-causing organisms also include *Bacillus cereus, Clostridium botulinum, C. perfringens, Cronobacter, Shigella, Vibrio, Yersinia enterocolitica, Hepatitis A virus, Noro virus, Cyclospora, Toxoplasma gondii* and *Trichinella spiralis*.

Conclusion

Global trends and events have brought public attention to the biological, health and economic interdependence of human relationships with animals as pets or food sources, wildlife and the social and ecological framework of shared living space, as food safety and security become paramount. Adoption of good manufacturing practices, strict biosecurity measures, maintaining hygiene, proper handling and storage of animal products, coordinated surveillance and well-developed monitoring systems are some of the critical measures to combat above mentioned zoonotic infections. Scholars, producers, consumers and government agencies need to be more conscious of the need to achieve food safety in order to provide food security for the world's population along with the protection of natural resources and promoting universal health. We must keep using fundamental scientific research to guide policies, practices and technological advancements to boost food production, enhance sustainable practices and achieving food safety.

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