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FOOD POISONING ASSOCIATED WITH MEAT, POULTRY AND EGGS: PATHOGENS, PUBLIC HEALTH RISKS AND PREVENTIVE STRATEGIES

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ABSTRACT
Food poisoning associated with meat, poultry and eggs remains a significant public health concern worldwide. These animal-derived foods provide essential proteins, vitamins and minerals but can also serve as vehicles for foodborne pathogens when production, processing, storage and preparation practices are inadequate. Important bacterial pathogens include Salmonella spp., Campylobacterjejune, Shiga toxin-producing Escherichia coli(STEC), Listeria monocytogenes and Clostridium perfringens. Food contamination may occur during animal rearing, slaughtering, transportation, processing, retail distribution and domestic food preparation. Consumption of contaminated or inadequately cooked products can cause gastroenteritis, dehydration, systemic infections and, in severe cases, life-threatening complications. Children, older adults, pregnant women and immunocompromised individuals are particularly vulnerable to certain foodborne infections. This review examines the major pathogens associated with meat, poultry and eggs, their routes of transmission, clinical consequences and broader public health implications. It also discusses preventive strategies, including hygienic animal production, appropriate refrigeration, adequate cooking, prevention of cross-contamination, food-handler education and implementation of Hazard Analysis and Critical Control Point (HACCP) systems. An integrated One Health approach involving human health, veterinary medicine, food production and environmental management is essential to reduce foodborne disease and improve food safety.

KEYWORDS : Food poisoning, meat, poultry, eggs, foodborne pathogens, Salmonella*, Campylobacter, public health, HACCP, food safety.

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1. INTRODUCTION

Food safety is an essential component of public health because contaminated food can cause illness, hospitalization, economic losses and death. Meat, poultry and eggs are widely consumed because of their nutritional value and versatility. However, their composition, handling requirements and potential exposure to microorganisms make them important commodities in food safety management.

Foodborne diseases may arise from bacteria, viruses, parasites or toxins. Contamination can occur at any stage of the food chain, from primary animal production to final consumption. The World Health Organization (WHO) emphasizes that unsafe food contributes substantially to the global burden of disease, with disproportionate effects on children under five years of age and populations in low- and middle-income countries.

Meat may become contaminated during slaughter, carcass dressing, cutting or processing. Poultry is particularly associated with Salmonella* and Campylobacter, while eggs can transmit Salmonellawhen the organism is present internally or contamination occurs on the shell and subsequently reaches the edible contents. Improper cooking, inadequate refrigeration and contact between raw and cooked foods can further increase the risk of infection.

Understanding the microorganisms involved and the points at which contamination occurs is essential for developing effective preventive measures.

2. OBJECTIVES OF THE REVIEW

The objectives of this review are:

1. To identify the major pathogens associated with food poisoning from meat, poultry and eggs.
2. To describe their sources, transmission routes and associated illnesses.
3. To examine the public health and socioeconomic consequences of foodborne infections.
4. To evaluate preventive strategies applicable throughout the food supply chain.
5. To highlight research needs for improving food safety and reducing foodborne disease.

3. MAJOR FOODBORNE PATHOGENS ASSOCIATED WITH MEAT, POULTRY AND EGGS

3.1 SALMONELLA SPP.

Salmonella is one of the most important bacterial causes of foodborne illness. Poultry meat and eggs are recognized vehicles of transmission, although the organism may also be associated with beef, pork and other foods.

Contamination can occur through infected animals, faecal material, contaminated equipment, handling practices or the food-processing environment. In eggs, certain Salmonella strains, particularly Salmonella Enteritidis, may contaminate the contents before the shell is formed. Shell contamination can also occur after laying.

Symptoms generally include diarrhoea, abdominal cramps, fever, nausea and vomiting. Severe infections may spread beyond the intestine, particularly in vulnerable individuals.

Preventive measures include flock monitoring, hygienic egg production, appropriate refrigeration, avoidance of raw or undercooked eggs, adequate cooking and effective sanitation throughout meat processing.

3.2 CAMPYLOBACTER JEJUNE

Campylobacter jejune is a major cause of bacterial gastroenteritis and is strongly associated with poultry. Birds may carry the organism without showing obvious symptoms. During slaughter and processing, intestinal contents can contaminate carcasses and equipment.

Infection commonly causes diarrhoea, abdominal pain, fever and nausea. Symptoms may appear approximately two to five days after exposure. Although many cases resolve without specific treatment, complications can include reactive arthritis and, rarely, Guillain–Barré syndrome.

Thorough cooking is effective against Campylobacter. Other important measures include farm biosecurity, hygienic slaughtering, safe transportation and preventing raw poultry juices from contaminating ready-to-eat foods.

3.3 SHIGA TOXIN-PRODUCING ESCHERICHIA COLI (STEC)

Certain strains of E. coli, including O157:H7, produce Shiga toxins that can cause severe gastrointestinal disease. Undercooked minced or ground beef is a recognized source of infection because contamination on the meat surface may be distributed throughout the product during grinding.

Symptoms may include severe abdominal cramps and bloody diarrhoea. In some cases, particularly among children, infection can lead to haemolytic uraemic syndrome, a serious condition that can damage the kidneys.

Preventive measures include hygienic slaughter practices, prevention of faecal contamination, adequate cooking of ground meat and separation of raw meat from foods that will not undergo further cooking.

3.4 LISTERIA MONOCYTOGENES

Listeria monocytogenes is associated with certain ready-to-eat meat products, processed meats and contaminated food-processing environments. Unlike many foodborne bacteria, it can survive and grow at refrigeration temperatures, although growth rates depend on environmental conditions and the food itself.

Listeriosis may cause mild gastrointestinal symptoms in healthy individuals but can lead to invasive disease in high-risk groups. Pregnant women may experience relatively mild illness while the infection causes miscarriage, stillbirth or severe neonatal infection. Older adults and

immunocompromised individuals are also at increased risk.

Prevention requires strict sanitation, control of contamination after cooking, appropriate storage and adherence to product-specific shelf-life requirements. High-risk consumers should follow official advice regarding ready-to-eat foods.

3.5 CLOSTRIDIUM PERFRINGENS

Clostridium perfringens can cause food poisoning when cooked meat, poultry, gravies or other prepared foods are cooled or held at unsafe temperatures. Its spores can survive some cooking processes and subsequently germinate when conditions permit.

Illness typically involves abdominal cramps and diarrhoea. Outbreaks may occur when large quantities of food are prepared in advance and cooled slowly or maintained at inadequate holding temperatures.

Rapid cooling, appropriate refrigeration, adequate reheating and safe hot holding are important control measures.

3.6 OTHER RELEVANT HAZARDS

Other hazards may also be associated with animal-derived foods:

- Staphylococcus aureus: Improper handling and temperature control may allow the organism to produce heat-stable enterotoxins in food.
- Toxoplasma gondii: Undercooked meat can transmit this parasite, with particular concerns during pregnancy and in immunocompromised individuals.
- Trichinella spp.: Certain undercooked meats, especially pork and wild game in relevant settings, may transmit parasitic infection.
- Antimicrobial-resistant bacteria: Resistant strains of foodborne pathogens can complicate treatment and contribute to the wider antimicrobial resistance problem.

4. ROUTES OF CONTAMINATION

Food contamination is a continuous-chain problem. Several stages can introduce or spread pathogens.

4.1 PRIMARY PRODUCTION

Animals may carry pathogens in their intestinal tracts or tissues. Contaminated feed, water, housing, bedding and the farm environment can contribute to pathogen circulation. Poor farm biosecurity may increase exposure between animals and their surroundings.

4.2 SLAUGHTERING AND PROCESSING

During slaughter, intestinal contents, hides, feathers, equipment and workers' hands can transfer microorganisms to carcasses or meat. Inadequate cleaning of machinery and processing surfaces may spread contamination between batches.

4.3 TRANSPORTATION AND RETAIL STORAGE

Temperature abuse during transportation, storage or retail display can allow certain microorganisms to multiply. Damaged packaging and poor separation of raw and cooked products may create additional risks.

4.4 DOMESTIC PREPARATION

Cross-contamination can occur when knives, cutting boards, utensils, hands or surfaces transfer microorganisms from raw meat or eggs to cooked food. Tasting raw mixtures, consuming inadequately cooked products and leaving perishable foods at unsafe temperatures can increase exposure.

5. PUBLIC HEALTH RISKS

5.1 CLINICAL CONSEQUENCES

Foodborne infections range from mild, self-limiting gastroenteritis to severe systemic disease. Common symptoms include diarrhoea, vomiting, abdominal pain and fever. Some pathogens cause complications affecting the kidneys, nervous system, joints or pregnancy.

5.2 VULNERABLE POPULATIONS

Young children, older adults, pregnant women and immunocompromised people face greater risks from particular pathogens. Public health advice and food-handling recommendations should therefore account for differences in individual susceptibility.

5.3 ANTIMICROBIAL RESISTANCE

The inappropriate use of antimicrobial agents in animal production can contribute to the selection and spread of resistant microorganisms. Resistant foodborne bacteria may reach humans through contaminated food, direct animal contact or

environmental pathways. Responsible antimicrobial use, veterinary oversight and integrated surveillance are therefore important components of food safety.

5.4 ECONOMIC AND SOCIAL CONSEQUENCES

Foodborne disease can increase healthcare expenditure, cause missed work and educational activities, disrupt food supply chains and damage consumer confidence. Outbreaks may also result in product recalls, trade restrictions and financial losses for producers and retailers.

6. PREVENTIVE STRATEGIES

6.1 GOOD AGRICULTURAL AND VETERINARY PRACTICES

Prevention should begin on farms. Measures include maintaining clean housing, providing safe feed and water, controlling pests, improving biosecurity, monitoring animal health and using veterinary medicines responsibly.

6.2 HYGIENIC SLAUGHTERING AND PROCESSING

Processing facilities should implement sanitary procedures, separate clean and contaminated operations, maintain equipment and train employees in hygiene. Monitoring of critical operations can help identify contamination risks before products reach consumers.

6.3 TEMPERATURE CONTROL

Perishable meat, poultry and egg products should be stored according to applicable food-safety requirements. Refrigeration slows the growth of many pathogens but does not eliminate them. Time and temperature controls are particularly important during cooling, transportation, storage and reheating.

6.4 THOROUGH COOKING

Cooking must achieve a safe internal temperature appropriate to the food and local food-safety guidance. A food thermometer is more reliable than judging doneness by colour alone. Ground meat requires particular attention because contamination may be distributed throughout the product.

6.5 PREVENTION OF CROSS-CONTAMINATION

Raw meat and poultry should be kept separate from cooked foods and produce that will be eaten without further cooking. Hands, knives, cutting boards and food-contact surfaces should be cleaned appropriately between tasks. Raw poultry should not be washed in a way that splashes contaminated water onto surrounding surfaces.

6.6 SAFE EGG HANDLING

Consumers should select clean, intact eggs from reliable sources and follow recommended storage practices. Raw or lightly cooked egg dishes should use pasteurized eggs when appropriate, especially when served to vulnerable individuals. Eggs should be cooked adequately, and utensils used for raw egg mixtures should be cleaned before reuse.

6.7 HACCP-BASED FOOD SAFETY MANAGEMENT

Hazard Analysis and Critical Control Point (HACCP) is a systematic approach for identifying, evaluating and controlling food safety hazards. Its implementation involves:

1. Identifying biological, chemical and physical hazards.
2. Determining critical control points.
3. Establishing critical limits.
4. Monitoring control measures.
5. Correcting deviations.
6. Verifying system effectiveness.
7. Maintaining accurate records.

HACCP should be supported by good hygiene practices, staff training, traceability and routine verification.

6.8 CONSUMER EDUCATION AND PUBLIC HEALTH SURVEILLANCE

Consumer education should emphasize safe purchasing, storage, preparation and cooking. Health authorities should strengthen laboratory diagnosis, outbreak investigation, food sampling and reporting systems. Coordinated surveillance across humans, animals, food products and the environment can help identify emerging risks.

7. ONE HEALTH APPROACH TO FOOD SAFETY

The One Health approach recognizes that human health, animal health and environmental

conditions are interconnected. Foodborne pathogens can circulate between animals, production environments, processing facilities and people.

Effective prevention requires cooperation among public health agencies, veterinary services, food producers, laboratories, regulators and consumers. Integrated surveillance can help detect outbreaks, identify contamination sources and monitor antimicrobial resistance.

The approach is particularly relevant to poultry-associated Salmonella and Campylobacter, for which interventions at the farm, slaughterhouse and food-preparation stages can work together to reduce exposure.

8. RESEARCH GAPS AND FUTURE PERSPECTIVES

Further research is needed to improve the prevention and detection of foodborne pathogens in meat, poultry and eggs. Important areas include:

- Development of rapid and affordable pathogen detection methods.
- Improved surveillance of foodborne disease and antimicrobial resistance.
- Evaluation of hygiene interventions in small-scale slaughterhouses and retail markets.
- Assessment of consumer food-handling knowledge and practices.
- Investigation of pathogen persistence in processing environments.
- Evaluation of practical, cost-effective cold-chain systems.
- Improved risk communication for vulnerable populations.
- Assessment of emerging technologies for pathogen reduction while maintaining food quality.

In India and other settings with diverse food supply chains, additional context-specific studies could help identify important contamination points in informal markets, small-scale processing units and food-service establishments. Such studies should use clearly defined sampling strategies, appropriate laboratory methods and transparent statistical analyses.

9. CONCLUSION

Food poisoning associated with meat, poultry and eggs remains an important food safety challenge because contamination can occur at multiple stages of production and consumption. Salmonella, Campylobacter, STEC, Listeria monocytogenes* and Clostridium perfringens represent important biological hazards, although their relative importance varies by food product and location.

A comprehensive prevention strategy must combine hygienic animal production, sanitary slaughtering, reliable temperature control, adequate cooking, prevention of cross-contamination, consumer education and effective regulatory oversight. HACCP-based management and One Health collaboration can strengthen these efforts by addressing hazards throughout the food chain.

Sustained research, surveillance and cooperation among food producers, public health authorities, veterinary professionals and consumers are essential to reduce foodborne illness and protect public health.

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