# ETIOLOGICAL IDENTIFICATION OF FOODBORNE TOXIC INFECTIONS BY TYPE OF PATHOGEN

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**Abstract.** Foodborne toxic infections (FTIs) remain a significant public health problem worldwide and are characterized by acute intestinal disorders caused by the ingestion of food contaminated with pathogenic microorganisms or their toxins. Etiological identification of the causative agents is crucial for accurate diagnosis, epidemiological surveillance, and the development of effective preventive measures. This review summarizes the modern approaches to the etiological identification of foodborne infections, focusing on bacterial, viral, and toxin-mediated pathogens. It also highlights the application of molecular diagnostic techniques and the role of microbiological and immunological testing in determining the causative agent of foodborne illness.

**Keywords:** foodborne infection, etiology, pathogen identification, bacterial toxins, diagnostics, microbiology, public health.

**Introduction.** Foodborne diseases are among the most widespread infectious conditions globally, representing a considerable burden on healthcare systems. According to the World Health Organization (WHO), more than 600 million cases of foodborne illness occur annually, resulting in approximately 420,000 deaths [1]. The etiological spectrum of foodborne toxic infections includes

bacteria, viruses, and bacterial toxins, with pathogens such as Salmonella spp., Staphylococcus aureus, Clostridium perfringens, and Bacillus cereus being among the most common culprits [2].

Etiological identification plays a central role in outbreak investigations, guiding clinical treatment, and informing public health interventions. Traditional microbiological methods, combined with modern molecular diagnostics, allow rapid and precise detection of pathogens responsible for foodborne diseases.

Bacterial etiological agents. Bacteria are the most frequent cause of foodborne toxic infections. Among them, Salmonella spp. Remains one of the leading etiological agents worldwide, often associated with contaminated poultry, eggs, and dairy products. The pathogenesis is primarily linked to enterotoxin production and intestinal invasion [3].

Staphylococcus aureus causes intoxication due to the presence of preformed enterotoxins in improperly stored food. The clinical picture develops rapidly—within 2–6 hours—manifesting with nausea, vomiting, and diarrhea. Detection relies on isolating the microorganism and identifying enterotoxin genes by PCR [4].

Clostridium perfringens type A causes foodborne illness through the release of heat-labile enterotoxin. Improperly cooked meat and poultry are the primary sources. Rapid anaerobic culture and detection of cpe gene fragments are essential for etiological confirmation.

Bacillus cereus produces two types of toxins—emetic and diarrheal—depending on the strain. The emetic toxin (cereulide) is associated with rice dishes, while the diarrheal form results from enterotoxin production in the intestine [5,8].

Viral and other pathogens. Although bacterial agents dominate, viral pathogens such as Norovirus, Hepatitis A virus, and Rotavirus are also

significant causes of foodborne outbreaks, particularly in institutional settings. Norovirus accounts for up to 50% of nonbacterial foodborne infections.

Etiological identification of viral foodborne diseases is based on RT-PCR testing and immunochromatographic assays for viral antigens. Proper differentiation from bacterial pathogens is vital, as treatment and preventive measures differ fundamentally [6,9].

Modern diagnostic approaches. Recent advancements in diagnostic technology have dramatically improved the speed and accuracy of etiological identification. Traditional bacteriological culture remains the gold standard for detecting viable organisms. However, molecular and immunological methods—such as polymerase chain reaction (PCR), multiplex PCR, enzyme-linked immunosorbent assay (ELISA), and next-generation sequencing (NGS)—are increasingly used for simultaneous identification of multiple pathogens and their virulence genes [7,10,11].

The combination of culture-based and molecular diagnostics enables comprehensive analysis of outbreaks, providing information not only about the pathogen but also about antimicrobial resistance and virulence profiles.

**Epidemiological Significance and Preventive Measures.** Correct etiological identification of foodborne pathogens allows timely epidemiological interventions, including source tracing, control of contaminated products, and public health notifications.

Prevention of foodborne infections requires adherence to hygienic food processing standards, temperature control, and education on safe food handling. Strengthening laboratory networks and data-sharing systems is critical for national food safety monitoring programs.

**Conclusion.** Etiological identification of foodborne toxic infections is essential for accurate diagnosis, clinical management, and effective outbreak control.

Advances in molecular microbiology, especially PCR and genomic sequencing, have revolutionized the identification of pathogens. Integrating these tools with traditional methods ensures a comprehensive approach to combating foodborne infections and improving public health safety.

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