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Review Article

Staphylococcus Aureus: A Major Pathogen of Food Poisoning

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Abstract

Food poisoning that involves multiple etiologies is reported from developing as well as developed nations.Among the microbial causes, *Staphylococcus aureus* is a major pathogen of food poisoning that can occur in sporadic and epidemic form. It may cause life-threatening infections in children, the elderly, and immunocompromised persons. Staphylococcal food poisoning is responsible for 241,000 cases in the United States annually. A variety of foods, such as meat and meat products, milk and milk products, poultry, egg, fish, vegetable salad, and cream-filled pastries are implicated as a source of staphylococcal food poisoning. Unhygienic handling of food is considered an important source of *S. aureus* contamination. Enterotoxins produced by *S. aureus* play a vital role in the pathogenesis of staphylococcal food poisoning. Due to ingestion of preformed toxins in the food, the incubation period of staphylococcal food poisoning is very short. The main symptoms of staphylococcal food poisoning are nausea, vomiting, abdominal cramps, and diarrhea. The detection of enterotoxin is highly imperative for the investigation of staphylococcal food poisoning. Most of the patients do not require any treatment as the disease is generally self-limiting and normally resolves within 24–48 h after onset. Hygienic production of food and education of food handlers about the principles of food hygiene are the main strategies for the prevention of staphylococcal food poisoning. The objective of this communication is to delineate the growing significance of *S. aureus* as a leading cause of foodborne intoxication.

Keywords: bacterium, enterotoxins; food handlers; food poisoning; *staphylococcus aureus*; unhygienic handling

Introduction

Foodborne disease, also known as foodborne infection, foodborne illness, or food poisoning, is any illness caused by eating or drinking the contaminated food or water that contains pathogenic microbes (viruses, bacteria, protozoa, helminths), as well as chemical or natural toxins [1]. These diseases are one of the major causes of morbidity and mortality around the world. Foodborne infections affect both men and women, all age groups, all seasons, and both rural and urban areas and they can occur in sporadic or epidemic. Foodborne infections affect roughly 20% of people in industrialized countries each year [2].

Contamination that occurs during production, collecting, transporting, and preparation, as well as during processing, makes food a possible source of human infection. Potential sources of food contamination include feces-contaminated water or soil, unsanitary handling, and the use of unclean utensils and equipment [3]. The presence of foodborne pathogens in ready-to-eat foods, milk and milk products, meat and meat products puts the consumers at risk and also causes the producers to suffer significant financial losses [4].

In many countries around the world, including India, *Staphylococcus aureus* is a leading cause of foodborne illness [5]. The bacterium is non-motile, non-encapsulated, and non-spore-forming, and it can be found as normal flora of human and animal skin and mucous membranes [6, 7]. *Staphylococcus aureus* is a facultative anaerobic, Gram-positive coccus that appears as grapelike clusters under a microscope and has large, round, golden-yellow colonies, typically with haemolysis, when cultured on the blood agar plates [8, 6]. Many strains of *S. aureus* show resistance to several antibacterial antibiotics [7].

Staphylococcus aureus is a desiccation and high osmotic condition tolerant organism that can survive in potentially dry and stressful habitats including the human nose, skin, and inanimate surfaces like clothing and

surfaces. It can thrive in a wide variety of temperatures (7°C-48.5°C; ideal 30-37°C) and pH (4.2-9.3; optimum 7-7.5) conditions [9]. Bacterial growth thrives in foods with a pH of around 7, and most animal food products, such as meat, fish, poultry, eggs, and milk, have a pH of around 7 [10].

Staphylococcus aureus infections range from mild skin infections to life-threatening ones; such as bacteremia, endocarditis, necrotizing pneumonia, toxic shock syndrome and food poisoning [11]. The ingestion of food containing pre-formed *Staphylococcus* enterotoxins causes staphylococcal food poisoning [12]. There are five serologically distinct enterotoxins (A, B, C, D, and E), with enterotoxin a being the most common cause of food poisoning outbreaks [13]. It is estimated that 30-80% of the human population are carriers of *S. aureus*, with 50% of them carrying food poisoning variants. As a result, unsanitary food handling must be regarded a major source of *S. aureus* contamination [14].

Food handlers or other surfaces, such as processing equipment, are usually where *Staphylococcus aureus* gets access to the foods. Although bacteria can be found on the skin of animals, water, soil, and other surfaces, bacteria from food handlers and other human sources are thought to be the most major contributors to food poisoning [15]. Baked desserts, such as cream-filled pastries, cream pies, and chocolate éclairs, meat and meat products, potatoes, tuna, chicken, turkey, ready-to-eat salads, eggs, poultry, milk, and dairy products are regularly contaminated by *Staphylococcus* enterotoxins (SEs) [15, 16 ,17].

Staphylococcal food poisoning is a major concern in public health programs around the world [18]. Staphylococcal food poisoning symptoms onset quickly (30 minutes-8 hours) and include nausea, violent vomiting, abdominal cramping, with or without diarrhea [19]. If there is significant fluid loss, physical examination may reveal signs of dehydration and hypotension [12]. Although staphylococcal food poisoning is generally self-limiting and resolves within 24-48 hours of onset, it can cause life-threatening infections in children, the elderly, and immunocompromised people [20, 6].

Staphylococcus aureus infections cause significant morbidity and mortality both in the developing and developed nations [21]. It accounts for up to one third of foodborne gastrointestinal illnesses [22]. It is a major cause of foodborne illness, causing an estimated 241,000 illnesses in the United States each year. However, because this condition is self-limited, there is a low (10%) rate of presentation to health-care facilities, resulting in a massive underreporting of the estimated 6 to 80 million cases that occur each year [23]. Foodborne illness surveillance systems in developing countries are poor. As a result, determining the true scope of the problem is challenging. As a result, the incidence of staphylococci-related foodborne infections is thought to be significantly greater than recorded, with many cases going unreported [24].

The diagnosis of *Staphylococcus aureus* is based performing tests with colonies. Coagulase, haemolysins, and thermostable deoxyribonuclease tests are all commonly performed [8]. Recent genetic advances have made it possible to identify and characterize clinical isolates of *Staphylococcus aureus* in a reliable and timely manner [25]. Real-time PCR and quantitative PCR are two of these techniques that are increasingly being used in clinical laboratories [26, 27] Several immunological methods based on monoclonal antibodies (e.g., ELISA, ELFA, and Reverse Passive Latex Agglutination) for determining the enterotoxigenicity of *Staphylococcus aureus* isolated from foods, as well as methods for separating and detecting toxins in foods, have been developed and used successfully to aid in the diagnosis of illness [28, 27]. Agglutination assays can be used to identify toxins generated by *S. aureus*, such as enterotoxins A to D and TSST-1. There are commercial latex agglutination tests on the market [29].

Effective approaches for preventing staphylococcal food poisoning strive to eliminate food contamination by high personal hygiene standards, hence preventing food contamination by food handlers. This will be accomplished through public awareness campaigns emphasizing the importance of hand washing, wearing gloves during food preparation, and storing foods at the proper temperature to inhibit pathogen growth and minimize toxin production, as heating food after toxin has formed will not be an effective control measure. Furthermore, people with purulent exudates on their skin should not be allowed to touch food until they have sought medical guidance. In general, measures, such as serving hot meals right after cooking, thoroughly reheating of cooked foods, rapid refrigeration of cooked foods, proper hand washing before and after food preparation, avoiding food service workers with skin infections in food establishments, and using clean utensils and equipment will certainly reduce the incidence of food poisoning outbreaks caused by *S. aureus* [30,31,32].

Conclusion

Staphylococcus aureus is a Gram positive bacterium that is the leading cause of food poisoning throughout the world. The organism is ubiquitous in distribution, and is found in the healthy and diseased humans as well as animals. The environmental contamination of foods is an important cause of staphylococcal food poisoning. It is emphasized that food handlers must be closely monitored during the preparation of food. Attempts should be made to develop a simple, sensitive and low cost technique to detect staphylococcal enterotoxins in food, and clinical specimens of the patients.

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Author's Contribution

All the authors contributed equally. They read the final version, and approved it for the publication.

Conflict Of Interest

The authors declare that they do not have conflict of interest.

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