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Potential threat to human health from foodborne illness having serious implications on public health- a Review

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Abstract

Food-borne infections are caused by the microbial load in food. If bacteria become numerous and the food is consumed, bacteria may continue to grow in intestines and cause illness. *Salmonella, Campylobacter,* hemorrhagic *E. coli* and *Listeria* all cause infections [1]. Food intoxication results from consumption of toxins (or poisons) produced in food by bacterial growth. Toxins released by bacteria cause illness in human beings. Common kinds of bacteria that produce toxins include *Staphylococcus aureus* and *Clostridium botulinum*. In the case of *Clostridium perfringens*, illness is caused by toxins released in the gut after consumption of huge numbers of vegetative cells.

Key words: Bacteria, food-borne infections, intoxication, toxins

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1. Introduction

Food is liable to be contaminated at any stage from producer to consumer. Mostly all outbreaks of food poisonig occur during the summer months. The significance of food to serve as a potential vehicle for transmission of certain diseases under certain circumstances is well known. Food serves as excellent culture and protective medium for certain microorganisms which may include potential pathogens capable of causing serious health problems. Food can also allow some organisms to grow and produce certain toxins there by making itself a vulnerable commodity from public health point of view. Food borne diseases can be transmitted from infection of animals that can be transmitted to man through ingestion.

In many European countries, food poisoning is not properly reported at times. There the veterinarians are generally vested with the duty of food inspection.

Commonly occuring food-borne infections of public health significance

a) Salmonellosis: There are a group of bacteria of more than 2300 types or species commonly known as Paratyphoid Bacteria. They inhabit in the intestine of clinically healthy man and animal and also pathogenic for men or animals or both. Salmonella can exist in feces or on pastures for considerable period. They are not destroyed in carcass or offal maintained at chilling or freezing temperature. Salmonella can also grow well on meat at ordinary temperature. It is probable cause of 75% of outbreaks of food poisoning *Salmonella* Typhimurium is found in rat, mice, cattle, sheep, goat, pig fowl and duck. *S. Enteritidis* also cause meat food poisoning and it is commonly found in rat, cattle, pig, goat and duck. Typical food poisoning commences within 7-72 h after ingestion of the organisms. The food involved are generally egg, meat and milk and is often derived from infected animals, but may also be contaminated during storage or preparation. Salmonella food poisoning is characterized by nausea, vomiting, chills, abdominal pain and diarrhea. Salmonella must be controlled during processing and manufacturing of animal feeds, by frequent disposal of animal excreta in

livestock farms and by transportation of livestock in convenient manner to reduce stress [1, 2, 4].

b) Campylobacteriosis: Campylobacteriosis or *Campylobacter enteritis* is caused by consuming food or water contaminated with the bacteria *Campylobacter jejuni*. *C. jejuni* commonly is found in the intestinal tracts of healthy animals and in untreated surface water. Raw and inadequately cooked foods of animal origin and non-chlorinated water are the most common sources of human infection. Diarrhea, nausea, abdominal cramps, muscle pain, headache and fever are common symptoms. Onset usually occurs in 2-5 days after eating contaminated food. Rarely deaths have also been reported. Preventive measures include pasteurizing milk, avoiding post-pasteurization contamination and properly cooking meat and allied products [1, 3-4].

c) Listeriosis: Listeriosis primarily affects newborn infants, pregnant women, the elderly and those with compromised immune systems. In a healthy non-pregnant person, listeriosis may occur as a mild illness with fever, headaches, nausea and vomiting. Among pregnant women, intrauterine or cervical infections may result in spontaneous abortion or still birth. Infants born alive may develop meningitis. The mortality rate in diagnosed cases is 20-35%. The incubation period is a few days to several weeks. Infection is usually derived from meat, poultry and fish products. Preventive measures for listeriosis include maintaining good sanitation, turning over refrigerated, pasteurization and avoiding post-pasteurization contamination of food products [1, 4-5].

d) Staphylococcal intoxication: Staphylococcus spp. of bacteria is found on the skin and in the nose and throat of most people; people with colds and sinus infections are often carriers. Infected wounds, pimples, boils and acne are generally rich sources. Staphylococcus also is widespread in untreated water, raw milk and sewage. When Staphylococcus bacteria get into warm food and multiply, they produce a toxin or poison that causes illness. The toxin is not detectable by taste or smell. The bacteria itself can be killed by temperatures of 120˚F. Symptoms include abdominal cramps, vomiting, severe diarrhea and exhaustion. These usually appear within 1-8 h after eating staph-infected food and last one or two days. The illness seldom is fatal. Foods commonly involved in staphylococcal intoxication include protein foods such as ham, processed meats, tuna, chicken, sandwich fillings, cream fillings, potato and meat salads, custards, milk products and creamed potatoes. Foods that are handled frequently during preparation are prime targets for staphylococci contamination [1,4, 6-8]. *Clostridium perfringens* food borne illness: *Clostridium perfringens* belong to the same genus as the botulinum organism. However, the disease produced by *C. perfringens* is not as severe as botulism and few deaths have occurred. Spores are found in soil, non-potable water, unprocessed foods and the intestinal tract of animals and humans. Meat and poultry are frequently contaminated with these spores from one or more sources during processing. Spores of some strains are heat resistant and can survive boiling for four or more hours. Furthermore, cooking drives off oxygen; kills competitive organisms and heat-shocks the spores, all of which promote germination. Sufficient numbers of vegetative cells may be produced by the bacteria under conducive conditions to cause illness. Foods commonly involved in clostridium illness include cooked meat and processed poultry products. Symptoms appear within 8-24 hours after contaminated food is consumed. They include acute abdominal pain and diarrhea; nausea, vomiting and fever are less common. Recovery usually is within one to two days, but symptoms may persist for one or two weeks [1, 4].

e) E. coli hemorrhagic colitis: *Escherichia coli* belong to a family of microorganisms called coliforms. Many strains of *E. coli* are saprophytes in animal gut. However, *E. coli* O157:H7 strain causes a distinctive and sometimes deadly disease. Symptoms begin with nonbloody diarrhea one to five days after eating contaminated food, and progress to bloody diarrhea, severe abdominal pain and moderate dehydration. In adults, the complications sometimes lead to thrombocytopenic purpura (TPP) characterized by cerebral nervous system deterioration, seizures and strokes. Minced beef is mostly associated with *E. coli* O157:H7 outbreaks, but other foods which include raw milk, unpasteurized foods not exposed to heat trteatment and untreated water are also implicated. Infected food handlers with the disease likely help spread the bacteria. Preventive strategies for *E. coli* infections include thorough washing and other measures to reduce the presence of the microorganism on raw food, thorough cooking of raw animal products, and avoiding recontamination of cooked meat with raw meat. To be safe, cook ground meats to 160^{o}F [1, 4].

f) Viruses: Nearly one-third of food poisoning incidences worldwide majorly in developed countries is believed to be viral in origin. In USA, viral food intoxications contribute to overall 50% cases annually including norovirus as prominent source, which individually share 57% of the total outbreaks in this regard. The severity of virus borne food intoxications have intermediate incubation period causing illnesses which may be self-limited or have the potential to spread among healthy individuals. Common viral etiology includes Enterovirus [1]. Hepatitis A causes viral illnesses through the carrier of food lasting for 2-6 weeks incubation period and generally characterized by its systemic nature of spread throughout the system of individual. It also leads to liver damage and dysfunction through causation of jaundice. Liver damage caused can be acute or chronic in nature. The infection can originate from consumption of fresh products or those which have been exposed to fecal contamination [9-10]. Apart from this other viral source include Hepatitis E, Norovirus and Rotavirus as significant in this course.

g) Parasites: These also contribute significantly towards causing food borne illnesses. Most of the food borne

intoxicoses by parasites is zoonotic in nature. These include Platyhelminthes: *Diphyllobothrium* sp., *Nanophyetus* sp., *Taenia saginata*, *T. solium*, the scolex of *T. solium*, *Fasciola hepatica* along with tapeworm and flatworm. Nematode: *Anisakis* sp., *Ascaris lumbricoides*, *Eustrongylides* sp., *Trichinella spiralis*, *Trichuris trichiura*.

h) Protozoa: *Acanthamoeba* and other free-living amoebae, *Cryptosporidium parvum*, *Cyclospora cayetanensis*, *Entamoeba histolytica*, *Giardia lamblia*, *G. lamblia*, *Sarcocystis hominis*, *S. suihominis*, *Toxoplasma gondii*.

i) Fish and aquatic sources: These include shellfish toxin, including paralytic shellfish poisoning, diarrhetic shellfish poisoning, neurotoxic shellfish poisoning, amnesic shellfish poisoning and ciguatera fish poisoning, Scombrotoxin, Tetrodotoxin (fugu fish poisoning).

j) Natural toxins: These kinds of toxins are contained in several food products which are natural in origin and are not derived from bacterial source. Animal flesh sometimes is rendered toxic from the products derived from plant sources in their feed. Plant toxins generally include alkaloids, Ciguatera poisoning, Grayanotoxin (honey intoxication), mushroom toxins, Phytohaemagglutinin (red kidney bean poisoning; which can be made inactivated by boiling) and Pyrrolizidine alkaloids which can infect food sources causing food borne toxicity to human beings. Some substances originating from plants are therapeutic in regulated dose but prove to be toxic in high dosage. Foxglove, derived from plant source, contains cardiac glycosides; Poisonous hemlock (conium) has medicinal uses.

k) Other pathogenic agents: These include non-conventional intracellular virus like agents called Prions, resulting in causation of Creutzfeldt-Jakob disease (CJD) in human.

l) Ptomaine poisoning: Another predominant food toxicity called "*Ptomaine poisoning*" which involves *ptomaines* (from Greek *ptōma*, "fall, fallen body, corpse") which are alkaloids obtained in decomposed and decaying vegetable and animal matters. However, the disease causing bacteria causing food borne illnesses do not produce ptomaine as toxin and so not used or scientific purposes nowadays in the field of zoonotic food borne toxicity.

m) Emerging foodborne pathogens: Many emergent foodborne illnesses are new to the field and are not completely understandable till date. Approximately 60% outbreaks are caused by new and emergent unknown sources derived from *viz., Aeromonas hydrophila, A. caviae and A. sobria*.

Overall strategic implementation of approved methods for controlling bacterial food poisoning: A brief overview

The food should be properly refrigerated for preventing food poisoning. Strategic rules for hygienic preservation of food for benefit to public health should be employed along with proper and strict survey of animal products from source to transformation industry and delivery points. The regulation of food quality should include traceablity of the source of food poisoning in final processed product for which it is needed to know the origin an adequacy of each ingredient i.e., keeping track record or history oif the animal from which it is derived and assessing the efficiency of processing technique. In this way the origin of any probable food poisoning can be tracked and regulatory measures for its control and prevention in processed products can be implemented. Enforcement of strict hygienic layouts like HACCP and preservation of perishable products through cold chain technique should be adopted. Veterinarians also have apivtal role to play in this entire process by promulgating enforcement laws [11]. Under domestic conditions, prevention of food intoxications and food safety practices generally include sufficient cooking at optimum temperature and followed by its prompt and effective refrigeration. However, some bacterial exotoxins released in food are resistant to heat treatment.

2. Summary

Exotoxins from bacteria alter the appearance, odor and flavor of food. Food-borne illness can be prevented by proper cooking, adequate heat treatment and refrigeration of food products. Certain guidelines have been laid down by the Food Safety and Inspection Service of USDA as essential in preventing bacterial food-borne illness [11-12].

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