



Food Contamination Poses a Threat to Food Safety

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ABSTRACT

Food plays a vital role in our life. The contamination of food is a global public health issue affecting developed as well as developing nations. The contamination can be caused by physical, chemical, and biological agents. Among the biological agents, bacteria are most frequently encountered as a cause of contamination throughout the world. There are several routes of food contamination that include handler, equipment, packaging material, and environment. The ingestion of food with bacteria like *Listeria monocytogenes* can cause life threatening infection, especially in children, pregnant women, elderly and immunocompromised subjects. The microbiological examination of food by employing standard techniques is essential for the assessment of quality and safety of the products intended for the human consumption. The prevention of food contamination at all stages of food supply chain is highly imperative from the safety point of view.

KEYWORDS: Food contamination, Foodborne infections, Food safety, Microbes

INTRODUCTION

Since antiquity, man is dependent on food for the survival. Food means any articles used for food, drink, confectionery, or condiment whether simple, mixed, or compound, or any substances or ingredients used in the preparation of the items [1]. Due to globalization, there is a growing demand for a wider variety of foods. Currently, a large range of foods, which can be obtained either from plant or animal sources, are available to humans throughout the world. Food plays a vital role for human beings as it is essential for the growth, repair, and energy besides performing several physiological activities. The contamination is the presence of harmful microbes or substances in food that can occur through various sources including water, air, utensils, food handlers, dust, cockroaches, flies, rodents, buildings, packaging materials, and others [1]. It is noteworthy that all foods are at risk of becoming contaminated and hence, increases the chance of the food making someone sick. The contamination of food by microbial agents is a worldwide public health problem. Food can serve as a vehicle for many microorganisms, and ingestion of such contaminated can cause disease in susceptible persons [2]. Therefore, it seems imperative to know how the food has become contaminated so that suitable measures could be taken to protect against it [3]. This communication is an attempt to describe the significance of food contamination from food safety point of view.

DIFFERENT TYPES OF FOOD CONTAMINATION

Contamination means the unintended presence of potentially harmful substances, including the microorganisms, chemicals, and physical objects in food [1]. Three types of hazards namely, physical (dirt, nail, hair, rat excreta, bird droppings, pieces of glass, stones, bones, wood etc.) chemical (arsenic, cadmium, mercury, lead, pesticides etc.), and biological (bacteria, viruses, pathogenic fungi, protozoan parasites and mycotoxins) can occur in the food, making it unsafe for the human consumption [2]. In addition, the cross-contamination, which is the transfer of harmful microorganisms from one person, object or place to another, is also observed in food processing plants. There are three main types of cross-contamination: person-to-food, equipment-to-food, and food-to-food. No matter what kind, there is always a transfer of microbes from a contaminated source to uncontaminated food. Direct cross-contamination happens when the raw food containing food poisoning pathogens, is touched with cooked or ready to eat food. Indirect cross-contamination occurs when the microbes are transferred from the raw food to ready-to-eat food via food handlers, hands, equipment, work surfaces, knives, or other kitchen utensils [1, 3].

AVOIDING CROSS-CONTAMINATION OF FOOD PRODUCTS

In order to avoid cross-contamination, it is necessary to keep



the raw meat, poultry and seafood covered, and store away from ready-to-eat food, fruit, and vegetables (Caution: never share the same kitchen utensils). Further, the raw meat should be stored at the bottom of the refrigerator to prevent any leaking juices that often contain live organisms dripping onto other foods [3]. Avoid washing raw meat and poultry as this can spread germs in the kitchen. Carefully remove the defrosting liquid and packaging material from frozen meat and avoid contact with other food. It is also important to note that cooked or otherwise heated food should not be cut on boards on which raw food was previously cut if it was not cleaned properly afterwards. The fruits and vegetables should not be left wet after washing. And of course, the hands must be washed thoroughly immediately after contact with raw food. The plastic or glass cutting boards can usually be cleaned in dishwashers at high temperatures (over 60 degrees Celsius) and are, therefore, more suitable than wooden boards for cutting the raw food. For example, the transfer rate of *Campylobacter jejuni* from chicken to cucumber is 2.4 times less for plastic cutting boards than for wooden boards [4].

An extremely important rule in kitchen hygiene is to cook food thoroughly. If food is properly heated with a core temperature of 70 to 80 degrees Celsius for two minutes, most of the microbes are killed. Often it is disregarded by food handlers and consumers. The kitchen towels, rags and sponges should be washed or changed every few days at a temperature of at least 60 degrees Celsius in the washing machine [5]. It is essential that protection against cross-contamination should cover the entire food chain, i.e. from purchasing, transport and storage to processing in the home kitchen.

FOODBORNE DISEASES - A GLOBAL PROBLEM

Food being rich in various nutrients provides a suitable medium for the growth and multiplication of a wide variety of microbes including bacteria, viruses, yeasts, and moulds. The microbial contamination of food is commonly observed as organisms are widely prevalent in our environment. Researchers have recovered various types of organisms from the air, water, and soil of food industries. One of the authors (M.Pal) has isolated *Staphylococcus aureus* from the skin lesions of food handlers and also from the equipment's and utensils used in food establishments. The food may be contaminated by various microbes at any stage of food chain from production to consumption [6]. Foodborne diseases of microbial origin can cause around 20 million cases every year globally [6]. It is therefore, very essential that food must be free from microbial hazards that pose serious risks to human health.

The most commonly contaminated foods include protein-rich products like raw red meat, raw chicken, unpasteurized milk, and raw or undercooked eggs (e.g. the foods which contain more protein, the better and faster the multiplication of

bacteria). The consumption of contaminated food containing harmful viruses, bacteria, protozoa, helminths or chemical substances, causes more than 200 diseases worldwide [7]. It is estimated that 600 million people become sick after eating contaminated food and 420,000 succumbed to death annually, resulting in the loss of 33 million healthy life years (disability-adjusted life-years) [7]. Further, in low- and middle-income countries, US\$110 billion is lost every year in productivity and medical expenses as a result from unsafe food [7]. It is pertinent to mention that children below 5 years of age carry 40% of the foodborne disease burden, with 125,000 deaths annually [7]. In this context, the World Health Organization has stated that diarrhoeal diseases are the most frequent illnesses following the ingestion of contaminated food and water [7]. It is pertinent to state that food handlers have a legal accountability to make sure that the food they prepare is totally free from the contaminants and safe for the use by the consumers [3].

The foods, which are not kept safe, can pose potential threats to the public health worldwide. Foodborne diseases cause serious and life-threatening health risk to the individuals with compromised immune system, and also to the pregnant women, infants, and elders. The foodborne illnesses are classified into three categories [3]:

Foodborne Infections

The ingestion of viable pathogenic organisms in the food causes the infection in the consumer. Some of the examples are brucellosis, campylobacteriosis, cryptosporidiosis, listeriosis, salmonellosis, shigellosis, streptococcosis, toxoplasmosis, tuberculosis, and yersiniosis.

Foodborne Intoxications

The consumption of preformed toxin by microorganisms in the food causes the poisoning syndromes in the consumer. The important examples are *Clostridium botulinum* poisoning, *Escherichia coli* poisoning, *Staphylococcus aureus* poisoning, and *Vibrio cholera* poisoning.

Foodborne Toxi-Infections

Invasive pathogenic microorganisms can produce toxins in situ after the ingestion with food and shows the symptoms of poisoning. The most significant examples are *Bacillus cereus* poisoning and *Clostridium perfringens* poisoning [8].

Many infectious diseases of multiple etiologies, such as amoebiasis, balantidiasis, cholera, colibacillosis, diphtheria, giardiasis, infectious hepatitis, listeriosis, norovirus gastroenteritis, paratyphoid fever, rotaviral gastroenteritis, shigellosis, staphylococcosis, streptococcosis, tuberculosis, typhoid fever, and yersiniosis can be transmitted through food handlers [1, 9-11].

FOODBORNE INFECTIONS - CASES AND DEATHS PER YEAR

In 2016, Rotaviral gastroenteritis caused over 258 million

cases, and almost 130,000 deaths in children under the age of 5 years worldwide [13]. It is mentioned that over 1.5 million cases of infectious hepatitis occur annually in the world [6]. Currently, more than 50 million cases of invasive *Entamoeba histolytica* infections causing over 100,000 deaths are reported each year [14]. Human noroviruses are the leading cause of epidemic and sporadic gastroenteritis across all age groups globally, and are easily transferred via ready-to-eat foods, often prepared by the infected food handlers. Norovirus gastroenteritis is responsible for around 685 million cases and 200,000 deaths annually [11]. And as early as 2010, 23,150 cases of illness and 5,463 deaths were documented for listeriosis, caused by *Listeria monocytogenes* (Table 1) [15]. It is significant to mention that food must be protected from contamination by keeping in good hygienic condition till it reaches to the consumer [3].

Table 1. Prevalence of *Listeria spp.* and *Listeria monocytogenes* of contaminated food products in Iran

Foods	<i>Listeria spp.</i>	<i>Listeria monocytogenes</i>
Ready-to-eat-foods	14.6%	9.2%
Poultry	18.3%	5%
Raw meat	8.5%	2.6%
Sea foods	10%	5.1%
Traditional dairy	7.3%	4%
Commercial dairy	3.2%	1.4%
Eggs	0.1%	0.2%

Ready-to-eat food products are predominantly the foods that are most frequently contaminated with *Listeria*. Note: *Listeria* in food is killed by heating, such as boiling, roasting or pasteurizing.

Source: 12.

IMPORTANCE OF FOOD SAFETY FOR COMMUNITY HEALTH

Food safety is a global public health issue that affects the health of the people throughout the world [16, 17]. It gives assurance that the food will not cause any harm to the consumer when it is prepared and/or eaten [1]. Food safety protects the food supply chain from the introduction, growth, or survival of dangerous microbial and chemical agents [17]. Food safety refers to all those hazards that may make the food unhealthy for the consumer. The consumption of unsafe food can cause foodborne infections and intoxications [2, 9]. Hence, it is very important that the good microbial, chemical, personal and environmental hygienic practices must be sincerely employed in all the food processing industries to protect the community from foodborne diseases that cause significant morbidity and mortality [16, 18].

It is documented that the food can be contaminated by unhygienic practices during handling, preparation, and storage thus compromising food safety and palatability. Therefore, it is important that food safety measures, such

as good manufacturing practice (GMP), good hygienic practice (GHP), and hazard analysis critical control point (HACCP), should be applied in food industries for the hygienic production of food without any contamination [1]. The detailed information on the microbial contamination of various food is described by earlier researchers [19-22].

CONCLUSION

Food is very essential for the survival of human beings. Food contains several nutrients that serve as an excellent media for the growth of a wide variety of microorganisms. The contamination of food with microbes can occur at any stage of food production. Some of the organisms including *Campylobacter jejuni*, *Escherichia coli* 0157:H7, *Listeria monocytogenes*, *Salmonella*, and *Yersinia enterocolitica* can cause serious foodborne infections in both sex and all age groups. It is emphasized to develop simple, sensitive, and low-cost test kits that can be widely used even by the poor resource countries at farm level to detect the microbial contamination of various foods.

ACKNOWLEDGEMENTS

The authors are highly grateful to Prof. Dr. R.K. Narayan for going through the manuscript and Anubha Priyabandhu for rendering computer help. This paper is dedicated to all the Physicians, Surgeons, Nurses, Laboratory Technicians, and other supporting staff of the hospital who are working day and night to save the life of COVID-19 patients.

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Citation: Mahendra Pal, Martin Hofmeister, "Food Contamination Poses a Threat to Food Safety", American Research Journal of Food and Nutrition, Vol 3, no. 1, 2021, pp. 1-4.

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