



Food Defense: An Introduction

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Abstract Food defense is the process of protecting food products from intentional contamination or adulteration, which aims to harm consumers, business establishments, or the public health. It refers to a system in place to prevent, protect, respond to and recover from the intentional introduction of contaminants into our nation's food supply. Food defense is to everyone's benefit. It must be supported by the public sector if the appropriate level of protection is to be provided. This paper provides an introduction to food defense.

Keywords food defense, food quality, food fraud, food safety, food security

Introduction

Food is any substance or product intended to be ingested by humans. Like water and air, food is necessary to sustain life. The food system in the United States continues to increase in complexity, diversity, and reliance on interconnected domestic and global systems.

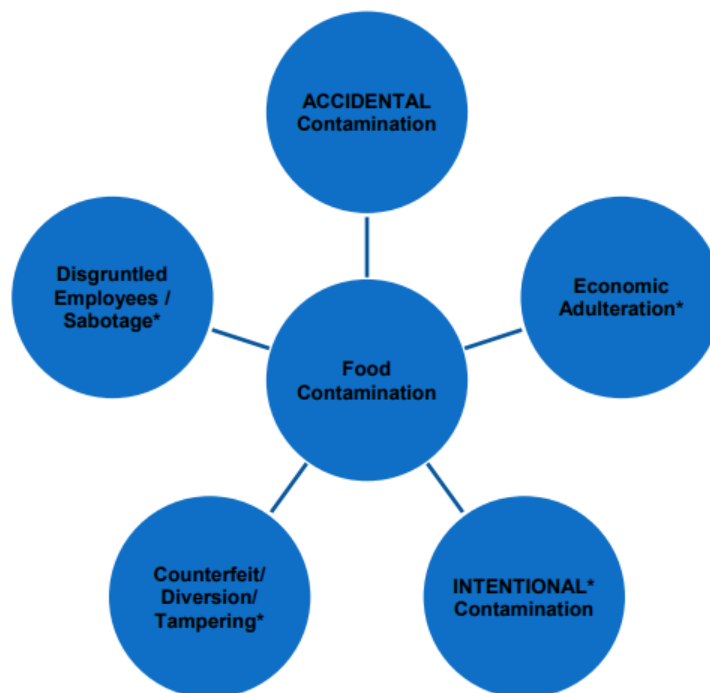


Figure 1: The spectrum of food contamination [1]



This caused the federal government in the early 2000s to declare the food and agriculture sector as one of 17 critical national infrastructure open to intentional attack. These infrastructures are food and agriculture, defense industrial base, energy, public health and healthcare, national monuments and icons, banking and finance, water, chemical, commercial facilities, dams, emergency services, commercial nuclear reactors, materials and waste, information technology, communications, postal and shipping, transportation systems, government facilities, and critical manufacturing. Terrorist attacks on critical infrastructures can cause problems to a national stability. Attack on the food and agriculture sector could have far-reaching consequences on the economy, human health, and consumer confidence.

Food defense is essentially protecting the food supply from intentional harm or contamination intended to cause public harm or economic disruption. A food is considered contaminated if it contains poisonous or deleterious substance. Contamination can occur at any point in the supply chain. Globalization has increased the number of points where contamination may occur. The food products that are most likely to be intentionally contaminated include meat, produce, dairy, and seafood. Intentional contamination may be caused by groups dissatisfied with how our food is produced, by people outside an operation, by disgruntled workers, or by shady business practices. Criminals may be motivated by personal revenge or financial gain. Figure 1 shows the spectrum of food contamination [1].

Concept of Food Defense

Food defense is the effort made towards protecting food from acts of intentional adulteration by biological, chemical, physical, or radiological agents introduced for the purpose of causing public health harm. It is closely related to food counterterrorism. It is crucial in proactively implementing programs that help avoid food safety incidents, costly recalls, and disruptions in food production. Food defense consists of a set of measures, strategies, procedures, and policies to prevent intentional adulteration of foods throughout the supply chain. The notion of “food defense” started in the aftermath of 9-11-2001 and was initiated by US government agencies. Shortly after the 9/11 the U.S. government became concerned that terrorist organizations might seek to contaminate the food supply.

Food defense is closely related food quality, food fraud, food safety, and food security, as shown in Figure 2 [1].

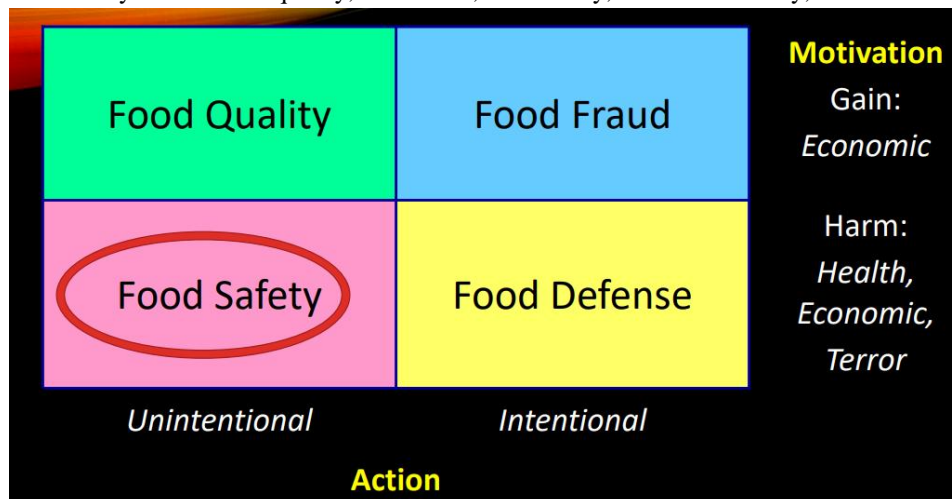


Figure 2: The interconnection of food safety, food quality, food defense, and food fraud [2]

Food defense is an essential element of an inseparable trio of responsibilities (food quality, safety, and defense). Food protection is the umbrella term embracing both food defense and food safety. Food defense may be regarded as the last piece in an integrated food protection jigsaw and it complements the food quality and food safety components [3].

- **Food Defense:** The protection of food products from intentional contamination or adulteration intended to cause public health harm or economic disruption. Food defense programs are intended to prevent acts by individuals who intentionally introduce contaminants into food products and cause harm to the company or to the consumer.



- **Food Safety:** Food safety addresses the accidental contamination of food products during storage and transportation. Food safety programs have focused on preventing unintentional contamination from metal, plastic, pathogens (such as viruses, bacteria, parasites), pesticides, or sanitizing agents entering the food supply.
- **Food Security:** This is the reliable availability of a sufficient quantity and quality of nutritious food for a population. Food security occurs when all people, at all times, have both physical and economic access to sufficient, safe, and nutritious food.
- **Food Fraud:** This involves fraudulent practices with an intent to deceive. Food fraud can be classified as substitution, artificial enhancement, addition, tampering, and dilution. It also includes the false or misleading statements made about a product for economic gain. While food fraud is economically motivated, food defense is ideologically motivated by individuals or organizations.
- **Food Quality:** This refers to characteristics of food that are acceptable to consumers. It is the attribute that influences a product's value to consumers. It is an essential food manufacturing requirement.

The food industry most commonly integrates a food defense into an existing food safety system of the company. It mainly focusses on food safety agents rather than food defense agents. The food industry implements food defense mainly in agricultural production, processing, storage and transport, wholesale and retail distribution. Therefore, it is important that food defense practices complement food safety practices. It is cheaper to prevent an incident from occurring than dealing with the aftermath of a foodborne disease outbreak.

Government Effort to Prevent Adulteration

The public holds government and the food industry responsible for protecting the food supply from contamination and preventing food defense events [4]. There are several stakeholders involved in food defense [5]. At the international level, we have Food and Agriculture Organization (FAO), World Health Organization (WHO), and World Trade Organization (WTO). Within the United States, we have Food and Drug Administration (FDA), United States Department of Agriculture (USDA), Food Safety and Inspection Service (FSIS), Centers for Disease Control and Prevention (CDC), Federal Bureau of Investigation (FBI), Department of Homeland Security (DHS), Food Protection and Defense Institute (FPDI), Food Protection and Defense Institute (FPDI), and Department of State.

The food industry needs the support of governments at all levels in order to implement realistic and workable food defense programs. The laws and government expectations regarding food defense vary from country to country. Various food defense tools and resources that have been developed by US government. Food defense is a collective term used by the Food and Drug Administration (FDA), United States Department of Agriculture (USDA), and Department of Homeland Security (DHS) to encompass activities associated with protecting the nation's food supply from deliberate acts of contamination. Figure 3 illustrates the evolution of US Food Defense Policy [1].

The Food and Drug Administration focuses on mitigation strategies to protect food against intentional adulteration. The FSIF provides an ongoing effort to help protect the nation's supply of meat, poultry, and egg products from intentional contamination. Proactive and reactive food defense practices can help prevent malicious attacks on the food chain, food fraud, food crime, food safety, food contamination, food tampering, food crime, and food terrorism.

The FDA and USDA adapted a tool called CARVER, originally used for military purposes, for vulnerability assessment in the food sector. CARVER is an acronym for the following six attributes used to evaluate the attractiveness of a target for an attack [6]:

- **Criticality**—refers to the impact of an attack on public health and the economy.
- **Accessibility**—refers to the ability to physically access and egress from the target.
- **Recuperability**—refers to the ability of a system to recover from an attack.
- **Vulnerability**—refers to the ease of accomplishing an attack.
- **Effect**—refers to the amount of direct loss from an attack as measured by loss in production.
- **Recognizability**—refers to the ease of identifying a target.



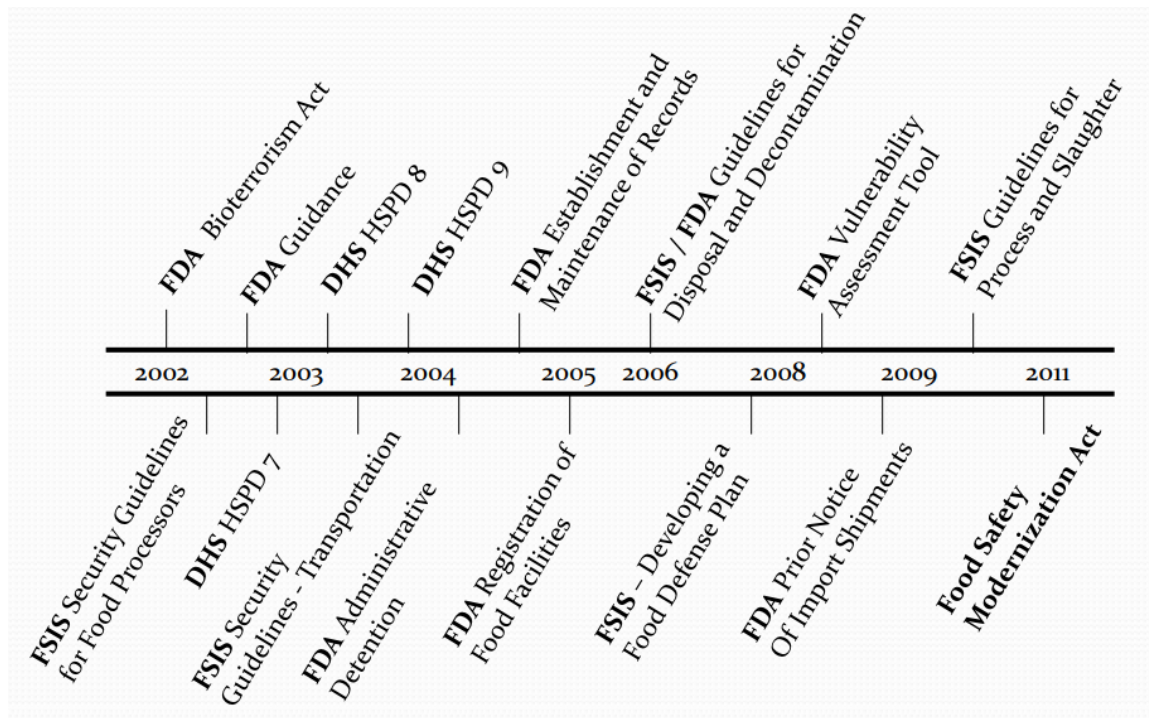


Figure 3: Evolution of US food defense policy [1]

Food Defense Plan

A food defense plan is a proactive, strategic approach to protect the entire food supply chain from an intentional deliberate contamination. All food company are encouraged to develop and operate with a food defense plan. A food defense plan is a document that sets out control measures developed by an establishment to prevent intentional adulteration of food product. It is also a practical guide used to keep food products safe from threats of intentional contamination. It is tool used by quality managers to help prevent the intentional contamination of food products. The plan should be developed, documented, implemented, tested, assessed, and maintained. Each facility should be required to prepare and implement a written food defense plan, which would include the actionable process steps, focused mitigation strategies, monitoring, corrective actions, verification, training, and recordkeeping. An organization should be able to assess, prevent, and respond proactively to a potential attack on the food chain. A good plan should be easy to understand and use, practical, implementable, and flexible. It must be science-based, making it compatible with a risk analysis framework. It should be comprehensive including suppliers, contractors, manufacturing employees, transporters, distributors, and all partners along the food supply chain [7].

Conclusion

Food defense is the effort to protect food from intentional acts of adulteration where there is an intent to cause public health harm and economic disruption. State agencies must do everything in their power to prevent attacks on the food supply chain. Just like other areas of critical infrastructure, the food industry is on the front line of new war. Food defense is relatively new in Europe and several other nations and the awareness of the food defense is not the same in all nations. Therefore, it is necessary to work on raising awareness on food defense. To increase awareness of food dense, some institutions have begun to incorporate food dense in their undergraduate curricula. More information about food defense can be found in the books in [8,9,] and the following related journal: *British Food Journal*.

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