

Terrorist Threats to Food & Water Supplies and the Role of HACCP Implementation as One of the Major Effective and Preventive Measures

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Contamination of food and water supplies for terrorist purpose is real and current threat. Recently many governments started to protect its natural sources in order to provide safe food & water supplies by putting new roles which helps to prevent or detect any possible contamination through food handling during processing and other services. In this study, we are going to introduce a new level of hazard, which we consider as the fourth level of food hazards and could be probably the most threaten one to food safety and that is THE INTERNATIONAL FOOD TERRORISM. Also, we are going to discuss the possible ways of terrorist attacks by using biological or chemical agents, starting from farms, processing, transportation, distribution and other stages of the sophisticated and long food chain processing and services. As there are many weak points that terrorist might exploit, we are going to show the major steps for developing a Security Plan Development (SPD) which can be realized easily and efficiently by implementing the principles of hazard analyses and critical control points (HACCP).

The response to the threat of intentional contamination of food and water supplies was swift after the events of September 11th a quick guidelines and many standard security practices were developed. Food safety plans, programs and systems such as HACCP systems which provide baseline security were introduced and implemented.

Terrorism is defined as the use of force or violence against people or property in violation of criminal laws, for the purpose of intimidation, coercion or ransom. **Food terrorism** is defined as the deliberate contamination of the food or water supply (1).

As it is known, there are three levels of food hazards, which are:

- (i) Global hazards (example: Bird Flu and Mad Cow disease).
- (ii) Regional or National hazards (example: hazard of Aflatoxin)
- (iii) Local food manufacturing hazards (example: fast food).

According to the world health organization WHO, the contamination of food for terrorist purpose is real and current threat, at the same time, contamination of food at one location could have global public health implication.

Nowadays, more chemicals and biological agents are related to the effects of aerosol exposure, many agents also could be delivered through food or water. These agents might be utilized including industrial or biological toxins and or microbial pathogens (2).

In general, food hazards or threats can be considered as follow:

- (i) Biological and chemical terrorism
- (ii) During crises or disasters, and away from proper food safety control in such situations, genetically modifies food can be sent to such areas in purpose to test a "new product" on human.
- (iii) Using incorrect information on labels for imported or exported food cans or articles.

Unfortunately, deliberate food and water contamination remains the easiest way to distribute biological, chemical or even physical agents for the purpose of terrorism. The major concern of any government all over the world is to protect its inhabitance and provide them with healthy environment and safe food & water supplies (3).

Food passing several stages in the long and sophisticated food chain processing before being consumed and in each stage can cause morbidity and mortality, and also destruction to food industry.

As the agriculture, food processing, food transportation and other food establishments are a vital part for security and health of any nation, all agencies, agriculture regulatory and health ministries have to work together with farmers, food manufacturers and distributors to address food safety and security (4).

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1. Possible used tactics by terrorist

In general, terrorist may use one or more of the following tactics in order to attack food resources or water supplies:

- (i) Attack facility from outside
- (ii) Gain access to facilities by forced entry
- (iii) Insider compromise using someone with legitimate access.

2. The agents may terrorist use in his attack

Terrorist may use biological agents such as bacteria and viruses, or chemical agents which can be characterized as chemical warfare agents such as nerve, blood and choking agent, also can used physical agents which can cause adverse health effects if eaten such as bone, glass fragments metals. All these agents can be delivered as liquid, aerosols or solid.

a. Biological agents

The potential results of an attack on the food supply can be inferred from numerous examples of unintentional food-borne disease outbreaks. Barbara A Rasco and Gleyne E Bledsoe in their unique book "*Bioterrorism and Food Safety*" examines the risks associated with the intentional contamination of food. It provides implementation strategies to reduce food security risks and discusses the underlying legal issues tied to product liability and regulatory compliance, including current hazards, provisions of the Bioterrorism Act, guidance documents from the FDA and USDA, and more. Risk management models are presented and workable strategies for addressing food safety risks are developed through case studies too (5).

Critical biological agents for public health preparedness can be listed in the following three categories:

- (i) Agents can easily cause high mortality and morbidity, and produce social disruption. One of these agents which can be ingestion in home canned food is *Clostridium botulinum* which is a neurotoxin. Food-borne anthrax also can cause high mortality and presents in two forms: oropharyngeal anthrax, a distinctive syndrome with low mortality and intestinal anthrax, which present as an acute abdomen-like syndrome.
- (ii) The second biological agent can cause moderate morbidity and low mortality. This category includes several food borne pathogens such as *Salmonella* spp., *Shigella* spp., *dysenteriae*, *E coli* and *Vibrio cholerae*.
- (iii) There are various food-borne pathogens that could be used also including viral and parasitic agents such as hepatitis A.

b. Chemical agents

A chemical attack is the spreading of toxic chemicals with the intent to do harm to people or to environment on our planet. A wide variety of chemicals could be made,

stolen, or otherwise acquired for use in an attack. Industrial chemical plants or the vehicles used to transport chemicals could also be sabotaged. Harmful chemicals that could be used in a terrorist attack include:

- (i) Chemical weapons (warfare agents) developed for military use.
- (ii) Toxic industrial and commercial chemicals that are produced, transported, and stored in the making of petroleum, textiles, plastics, fertilizers, paper, foods, pesticides, household cleaners, and other products.
- (iii) Chemical toxins of biological origin such as ricin. The toxicity of chemicals varies greatly, some are acutely toxic (cause immediate symptoms); others are not very toxic at all.

3. How toxic chemicals can be used in a terrorist attack?

The release of toxic chemicals in closed spaces could deliver doses high enough to injure or kill large number of people. In open areas, a toxic chemical cloud (plume) would become less concentrated as it spreads and would have to be released in huge amounts in order to produce large number of casualties. Potential delivery methods of toxic chemicals include:

- (i) Ventilation systems of a building.
- (ii) Misting, aerosolizing devices, or sprayers.
- (iii) Passive release (container of chemical left open).
- (iv) Bombs, mines, or other explosive devices that contain chemicals other than those used to create the explosion.
- (v) Improvised chemical devices that combine readily available chemicals to produce a dangerous chemical.
- (vi) Sabotage of plants or vehicles containing chemicals.
- (vii) Introduction of toxins in the food and water supply.

4. Exposure through Contaminated Food

Chemical agents can make food highly toxic, sometimes without changing the appearance or taste of the food. Butter, oils, fatty meats, and fish absorb nerve agents so readily that removal of the agents is virtually impossible. Food in bottles cans, or wrappings are not affected by agent vapor and can be salvaged following decontamination. The food supply is vulnerable to intentional contamination by toxins such as botulinum toxin.

5. Hazard management.

As we mentioned earlier, food passing many processing steps or stages starting from farms to the consumers, thus operations and stages in sophisticated food processing require developing food safety plans including risk assessment. During food processing, all people are responsible for identifying potential risk and adjusting appropriately. Hazard and risk can be identified by using plan and process that ensure the best food safety and security. The key to such challenge is prevention, and that can be built by identifying where in the chain contamination can occur or be eliminated. The best strategy is the adoption of Hazard Analysis and Critical Control Points (HACCP).

In general, a terrorist attack on large farms and food processing plants with widespread distribution, as vulnerable targets for food terrorism, could occur at any point along food supply and terrorist could create harm through a) final product contamination b) disruption of food distribution system c) introduction devastating crop pathogens or exotic animal diseases.

Let us start from the beginning, how can we prevent such food hazard or threat? Programs designed to prevent terrorism are simply based on three steps and they are: a) Prevention, b) Detection and c) Response.

5.1. Food resources and sophisticated food chain (from farm to fork)

In the following paragraphs, we are going to discuss the possible terrorist threats or attacks for the main links in the conventional food chain starting from farms and ending with final consumers.

a. Farm level

Good agriculture practice (GAP) where general risk prevention is advocated. These can be considered as pre-requisite programs for full adoption to HACCP systems or programs. HACCP can be used to implement good agriculture practices, which may reduce or eliminate food safety risk. Agriculture production areas can be vulnerable to deliberate contamination, such as with highly toxic pesticides and other chemicals. Irrigation water can be easily contaminated with chemical or biological agents. Subsequent processing may provide HACCP where contamination can be detected and controlled. Security measures, such as control animal feed ingredients and safety assurance systems should be include in the quality control of such ingredients or additives. Farms have to develop a plan for isolation, cleaning and disinfects ion. A record for new animals' feed and other products is a must. Security measures should be also considered during the rest of the processes such as manufacturing, transporting and distributing (6).

b. Storage and Transportation

There are several precautions which can be taken; physical measures, such as fencing and locks which can be used to secure storage facilities and transport containers. Transportation includes transport food from farm to factories and the distribution chains to customers and restaurants.

c. Processing

Prevention in such area starts from improving onsite security programs, such as restricting rights of entry and exit and locking up storage bulks. Hazard Analysis and Critical Control Points (HACCP) system can be implemented to prevent deliberate contamination into processing operations. The introduction of raw materials into the processing stream

is a Critical Control Point (CCP) in the most of processing operations.

Water is one of the most important raw materials used in food manufacturing and in food processing (washing and cleaning purpose), thus, precautions have to be taken including water analysis and it is very often a Critical Control Point CCP.

Air systems are also very important and can be serious source of food contamination. Heat treatment is a step in food processing and it is often a Critical Control Point for microbiological contamination. Security in processing area is a must, and should be monitored and controlled. Written plans and procedures have to be developed, with crises management teams that can quickly asses the scope of potential problems and contain them efficiently and promptly (7).

d. Wholesale and Distribution:

Wholesale establishments and markets are among the most vulnerable parts of the food supply system. Inspection of incoming ingredients, compressed gas, packaging and labels are very important. Controlled access and increased vigilance including security are required. More secure containers for bulk foods and the use of prepackaged materials are useful to prevent deliberate contamination. Buyers should be suspicious of being sold food at much less prices or from outside the normal distribution systems. There is a very important and difficult area which related to the employees of food industry, background checks including their mental health (8) will be of a great help.

f. Food Services and Restaurants:

Condiments in open containers used in restaurants and institutional are vulnerable to deliberate contamination. In all restaurants there should be a hazard identification and risk assessment. Drivers who distribute food have to be well-known, identified and medically checked. Trucks have to be sealed or locked upon arrival. No un-authorized person can enter the restaurant through back doors. Storage area has to be monitored at all the time. The left over food has to be destroyed immediately in a correct manner in accordance to a written procedure.

5.2. Water supplies

The possibility that terrorists may deliberately contaminate water supplies must be taken seriously into consideration. Drinking water can become contaminated at original water source, during treatment, in the pipes that distribute water and surface water such as rivers can be exposed to terror attacks (9). Attacks on the nation's water supply can come in many forms. Contamination from chemical or biological agents or merely disruption to the processing, filtration and distribution are two types of attacks. The primary threats to the nation's drinking water supplies are contamination by chemical, biological or radiological agents; damage, destruction, or sabotage of

physical infrastructure; and disruption to computer systems. Contamination of a reservoir with a biological agent would not likely produce a large risk to public health because of the dilution effect. These reservoirs contain hundreds of thousands and in some cases millions of cubic meters of water. If agents were to be introduced at this point they are likely to be detected and unlikely to survive the chlorination process. Even so, filtration and disinfection of the water may occur down stream mitigating the contamination. On the other hand, cyber-terrorism is potential threat to disrupt service. Computer networks and digital monitoring technology play a key role in the management of water supplies. Water facilities need to ensure that their vulnerability assessment and security measures are reviewed constantly, including facilities and employees. Safeguarding checkpoints could be used in every water utility. Once water or water utilities are contaminated by toxic bio-agents, cross-contamination could be a sequential problem. An electricity blackout can cause also damage and threat, in 2003 affected 50 million people in the northeastern and mid-western U.S. and Canada. Typically, blackouts are caused by severe weather damage or facility equipment failures, most of which can be repaired quickly. But, for destruction of electricity facilities caused by terrorism, the situation would be much more serious. The electricity blackout in 2003, though not itself the result of a terrorist attack, underscores the vulnerability of electric power transmission lines to such attacks.

5.3. Steps for Developing a Security Plan (SPD)

A Security Plan Development (SPD) can be realized easily and efficiently by implementing the principles of hazard analyses and critical control points (HACCP). A team of experts should be established first in order to develop the security plan (SPD). SPD team then will develop an evaluation work for the establishment, buildings, storages and all other facilities including water and power supplies. The SPD team will then implement the HACCP principles in order to:

- Develop a flow chart depicting an operation from primary production to consumption.
- Develop adequate records.
- Examine each step to determine whether there significant food security hazards.
- Determine the points in the operation that are critical for managing a specific risk.
- Develop preventive or risk control measures to reduce hazards to acceptable levels.
- Develop monitoring procedure of each critical control point in the security plan.
- Develop a procedure as a corrective action program under HACCP to fix security problems.
- Test or verify periodically the developed security program to ensure that it works properly.

4. How can we prevent threat?

Prevent and respond to the food safety emergencies must be close to effective responses. It is everyone's responsibility all over the world in such manner.

Prevention and response are the two major strategies for countering the threat of food terrorist (10):

a. Prevention

In fact, prevention is the most desirable option. The key to prevention food terrorism is enhancing existing food safety programs and implementing reasonable security measures. Food industry has both the responsibility and the capacity to reduce the likelihood of deliberate contamination of food. Governments should support industry in strengthening existing food safety management systems. Governments also have a role in promoting prevention food safety through established voluntary and regulatory mechanisms. Typical food safety management programs within the food industry include good agriculture practice (GAP), good manufacturing practice (GMP) and hazard analysis and critical control point (HACCP) and other HACCP based systems.

As with other aspects of food safety programs, priorities for action are determined by an analysis of the hazard specific for each food operation. The risk should be analyzed for each link in the food chain, taking into consideration the presence and availability of chemical and biological agents. Food can be contaminated by chemical or biological agents at any point in the food chain; food safety management programs offer opportunities for the prevention, detection and control of food terror. Governments should work with industry to incorporate considerations of food terrorism into food safety management programs. Cooperation with industry to develop protocols for assessing the vulnerability of individual food business, including assessments of the site, security and personnel and potential ways in which food might be contaminated.

b. Surveillance, Preparedness and Response

Sensible precaution coupled with effective surveillance, preparedness and response system can do much to counter food terrorism. Overt acts of food terrorism must first be detected by surveillance and other alert system before response can be activated. The main requirement for rapid detection is a system that is sensitive for identifying small cluster of illness. Surveillance system also provides information about the expected frequency and size of disease outbreaks. Early detection of disease resulting from covert food terrorism depends mainly on sensitive surveillance system.

The effectiveness of response to a great extent on preparedness plans that are developed and implemented long before any event occurs. Planning should consider the ability of the surveillance system to detect food safety emergencies, plans should be tested in exercises.

ROLE OF HACCP

Response to food terrorism depends on awareness of the possibility of a terrorist act and recognition of the incident as involving food. Emergency response systems must be developed within preparedness planning and should be maintained, tested and modified continually in order to adjust to new circumstances (11).

CONCLUSION

As a matter of fact, the possibility of contaminating food and water supplies deliberately by a terrorist attack must be taken seriously. The key to preventing from terrorist attacks is coming from improving quality control and implementing a reasonable security measures at production facilities based on vulnerability assessment. There may not be an optimal system for all food businesses at all stages along the sophisticated food chain but current HACCP approaches have clear benefits.

Preparedness planning is critical to assess susceptibility to deliberate contamination. Prevention strategies could include looking service reservoirs or high level of distribution tanks with routine checks for tampering. Food, beverage and drinking industries can also develop plans that would reduce the risk of product contamination by adding protective barriers such as UV light.

Reducing the risk of terrorist will require an unprecedented degree of cooperation among the public health, government, utilities, commercial and other private sectors. WHO has developed guideline on preventing terrorist threat to food to assist Member States? All countries must have basic systems to prevent deliberate contamination of their food supplies and, if attacked, to respond rapidly to minimize the health, economic and other effects. Cooperation between countries has to be activated and exchanging information is something very important to minimize threat and contamination on national, regional and international levels.

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