

Technology--the solution to prevent terrorism in the us food system



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Ever since the incident of 9/11, the threat of food terrorism in this globalized world is real and the US is significantly vulnerable to such threats.

Technology can do a lot in preventing and tackling terrorism in the US food system by deploying various tools and security measures at its disposal. The paper attempts to explore some of the important technologies that can make our food system more secure. CARVER+Shock is one such tool that can be used for risk assessment in the food delivery system. PulseNet uses DNA fingerprinting of the bacteria to define and detect outbreaks spread through food delivery systems. Thermal Imaging is a non-contact, non-invasive kind of technique to detect food contaminations or modifications. It converts the invisible radiation emitted by a body or object into temperature data. This helps detect a specific kind of contamination in the food. Thermal Imaging can best be used for detecting foreign bodies and pathogenic objects in food material.

This paper will also examine the recent technological advances in global food security that include Duponts BAX detection system and RiboPrinter system as these technologies can help in meeting the challenges posed by possible food terrorism in nation's food delivery system. DuPonts RiboPrinter system is also not only user friendly but detect the biological contamination with accuracy because it analyses genetic information for identifying the specific strain. The paper concludes with recommendations based on current objectives to thwart risks posed by terrorists in food systems so that major losses and damages can be averted.

Introduction

In the world of globalization, food outsourcing and food movement is a

common phenomenon depending upon its cost economics and supply

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abundance. However, at the same time, this raises the risk of food terrorism by introducing harmful pathogens or chemicals. Terrorist groups or individuals are inventing newer and newer ways and means, without limiting themselves to any specific geographical region, to achieve their ulterior motives. What happened on 9/11 was not anticipated by the US government and people in their dreams. Taking heed from the ominous incident of 9/11, it is prudent to assume that terrorists can go to any extent to spread terrorism by getting access to food supply and incorporating biological or chemical agents and jeopardize the existence of large populations. In the new millennia, food supply has been recognized as a major risk area of mass destruction - much bigger in proportion than what has been witnessed on 9/11. Stinson (2005) argues, " A catastrophic food terrorism event will cause the economy to shift to a new lower growth path" (1). Apart from huge human loss, the nation then can never come back to the old growth trajectory. Stinson et al. (2006) state, " Deliberate contamination of the nations food supply is a real possibility". The paper aims at exploring available and emerging technologies to detect food contamination that may be engineered deliberately.

US Food Industry and the Recent Developments

The food industry and Policy makers have begun recognizing the need of defending food supply chain from terrorism; however, there is no single agency that is responsible for the safety of food. In fact, the Departments of Agriculture (USDA), Homeland Security (DHS), Health and Human Services and the Environmental Protection Agency (EPA) all act towards achieving the food safety (McDonald, 2011). Moreover, numerous agencies such as public health offices, quality assurance laboratories, poison identifying agencies, <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

government approved forensic laboratories and many more are involved in dealing with the food delivery system and it becomes essential that they not only communicate with each other frequently but also work in close liaison to mitigate the likely threat imposed by terrorists group (WHO, 2008). Though the Food and Drug Administration (FDA) has taken many steps to ensure that food available to consumers is safe, it is not sufficient to prevent food terrorism. For example, the Food Safety Modernization Act enacted in late 2013 focuses on mitigation strategies to prevent terrorist-tampering in the food supply chain. Milk reaches to most households in the US on daily basis and is consumed fast due to limited shelf life. Milk poisoning or contamination could be most devastating as it is consumed by children and old alike. Along with food safety laws, what is important is technology to quickly detect the contamination.

Technologies and Current Status

I CARVER + Shock

The CARVER + shock is essentially a tool that can be employed to thwart food terrorism. It can be used to assess associated risks at different levels and points of entire food supply chain including individual processes and facilities and to find vulnerabilities. This can be used to evolve a system to find possible weak links in the entire system or operations and plug those weak points to eliminate possibility of attacks on food chains. Initially, it was the US military that developed CARVER to identify vulnerable areas of terrorist attack. Later, the US FDA deployed it for agriculture and food sector.

CARVER is an acronym of six attributes: Criticality, Accessibility,

Recuperability, Vulnerability, Effect, Recognizability. CARVER also adds one

more attribute " shock" to evaluate an after-effect in the event of terrorist
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attack (US FDA, 2013).

Each attribute signifies as per the following.

Criticality: Likely impact on economy and public health after a terrorist attack

Accessibility: The ease with which a terrorist or its group accesses the target

Recuperability: The possibility of recovery after an attack

Vulnerability: The proneness to a terrorist attack

Effect: Possible loss from a terrorist attack

Recognizability: Ease of identifying a target for a terrorist attack.

CARVER has been developed as a software program that helps companies identify vulnerable areas through a series of questions asked to several persons about their processes and facilities in the company. The company can assess its food supply chain regardless of its type - whether a generic or a specific one. It develops and tracks the flow diagram of the process under consideration for analysis. Each attribute is ranked on a scale of 1 to 10 depending upon the basis of measurements that have been developed. Less vulnerable processes are assigned lower values while higher vulnerable processes are given higher numbers (US FDA, 2013). The advantage with CARVER is that it helps company to think in the same way as an attacker usually thinks to identify weaknesses and then work out remedial measures to counter them. Counter measures could be any either enhancing physical security or checks in operations or modifying the process itself. CARVER program helps companies to become proactive in its planning process and equip them to thwart possible terrorists act pertaining to food supply chain (US FDA, 2013).

Vulnerability assessment and threat assessment together make overall risk
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assessment. CARVER+ shock program has been used to assess risk associated with foods such as baby food and infant formula, milk, egg products, yogurt, ice cream, soft drinks, fruit juices, flour, peanut butter, beef, seafood, bottled water, dietary supplements, vitamins, canned food, cereals, corn syrup, poultry products, have been assessed for initial risk rankings. Certain biological agents such as Salmonella, Clostridium, Bacillus anthracis have also been assessed in causing large scale disruptions. CARVER+Shock tool breaks down hazard and exposure into distinct characteristics that are better defined and can also be scrutinized independently. Each of the characteristics can be measured quantitatively. It also examines psychological consequences of an attack along with economic and health consequences. When food system is broken into smaller nodes or pieces, it is easy to identify critical nodes that are most vulnerable to terrorist attack. Then identification of countermeasures becomes easy to lessen the risk perceived at critical nodes. It involves expertise of several fields such as food microbiologist, epidemiologist, tampering expert, botanist, toxicologist, plant pathologists, medical doctor, food chemist, veterinarian and many more.

CARVER also develops and evaluates terrorist profile based on intelligence gatherings and make use of it for risk analysis. Potential countermeasures consist of security procedures, awareness, process technology alterations, analysis and testing, government role. Awareness spreading is an important aspect and that can be done through training courses, industry guidance and vulnerability assessments.

II PulseNet

PulseNet, under the auspices of CDC, came into existence when in 1993, <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

over 700 people got affected and 4 children killed when they ate hamburgers infected with *Escherichia coli* (*E. coli*). At that time, health departments did not have relevant data to determine the common food source responsible for this outbreak. PulseNet, a network of 87 laboratories, then provided the testing methods, and associated technology to find association of illnesses to a food source. PulseNet employed Pulse-field Gel Electrophoresis (PFGE) to determine the *E. Coli* infection. PulseNet is a network of public health laboratories capable of performing fingerprinting of foodborne illness-causing bacteria. PulseNet can detect even subtypes of a variety of bacteria that include shigella, *Vibrio parahaemolyticus*, *Vibrio Cholerae*, *Clostridium botulinum*, *Campylobacter jejuni*. PulseNet uses DNA fingerprinting technique and database to find quickly the cause of outbreak. In short, database with PulseNet could be immensely helpful to find the kind of bacteria and its strain by comparing PFGE patterns (CDC, 2013). PulseNet network now exists in many parts of the world that include Asia, Africa, Europe, and Australia region and most leading countries. It is a universal method for subtyping of bacteria with a little bit of changes depending upon the kind of bacteria that is under investigation. Only the conditions for electrophoresis and the choice of restriction enzyme require to be optimized for each species. When PFGE method is highly standardized, it is possible to generate stable patterns at the different laboratories.

PFGE is essentially a subtyping technique employed when conventional agarose gel electrophoresis cannot be used to separate DNA fragments.

PFGE conducts " the differential migration of large DNA fragments through agarose gels" by making frequent changes in the direction of the electrical

field during electrophoresis. The below mentioned picture depicts the flow <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

diagram of PFGE process (PulseNet International, 2013).

Source: <http://www.pulsenetinternational.org/international/pulsenetexplained/#limitations>

III Thermal Imaging

Thermal imaging technique measures the infrared radiation of the object through infrared detectors and then converts them into a thermal image to show temperature distribution. Every object above absolute Zero (-273 degree C) emits heat radiation. Thus, thermal imaging is used in detecting foreign bodies in grains. Foreign bodies could be dirt, stone, insects, pathogens or any harmful substance. Nanje Gowda and Alagusundaram (2013) argue, “ Thermal imaging is an exceptional alternate method which can sense the temperature distribution across a specific area of interest by capturing a thermal image using infrared camera” (39). It is important to note here that the performance of imaging system largely gets affected by wind, temperature, solar radiation, and moisture content. Hence the scope of improvement cannot be denied in the Thermal Imaging technology that can tolerate the above mentioned environmental impacts.

Thermal Imaging is still passing through experimental stages and further research work is necessary to establish its use in restoring food security.

IV Hazard Analysis and Critical Control Point (HACCP)

“ HACCP is a new methodology that has been introduced to replace the old quality control (QC) and quality assurance (QA) programs” (). Initially, QC and QA used to follow a particular protocol in giving the result of the tested foods. Unlike the two, HACCP system is formulated in a way that enables it to enhance food safety via recognizing sources of possible impurity and

providing specific ways of deterring them through changes in process as well <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

as structure. It was designed to avert unintentional contamination. However, in using technical in addition to scientific principles in analyzing food hazards makes it one of the methods used in curbing food terrorism. This method is widely used worldwide because of its success in enhancing food safety.

V Food Defense Plan Builder

“ FDPB is a user-friendly software program designed to assist owners and operators of food facilities with developing personalized food defense plans for their facilities” (). This software system is a user-friendly tool that harnesses existing FDA tools, guidance as well as resources for food defense to form one single application. The sections that enhance the success of FDPB include Company Information, Broad Mitigation Strategies, and Focused Mitigation Strategies. Other sections also include Vulnerability Assessment, Emergency Contacts, and Action Plan as well Supporting Documents. This software system is highly advocated by CDC; CDC recommends it and calls for organizations to install the software in their computer systems. FDPB is likely to be used extensively in the world in the near future because it is free and also efficient in monitoring food production.

VI Drones

Drones are small gadgets that use electrical power to suspend in air and monitor what is taking place at the ground without being recognized. They are controlled from varying places and do not require the presence of a person in them. Destruction of research laboratories and burning of crops are some of the methods employed by terrorists in crippling America. Protecting such big areas requires allocation of many officers in different points.

Technological advancement has however played a very significant role in <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

this part. It has led to the introduction of drones that monitor big traces of land without being recognized by the offenders. Currently, the U. S. is advocating the extensive use of the drones in monitoring agricultural lands so as to curb insecurity challenges posed by terrorists.

Limitations of the Technologies

a CARVER+ Shock

The major drawback with CARVER system is that all questions may not be relevant to everyone because each person operates in a specific area or processes. Moreover, security management of the establishment would like to estimate conditional risk for the given application. Biringer et al. (2007) argue that it is difficult to predict human behavior because they persistently learn, plan, practice and modify their behaviors. Moreover, it is also true that past data may not help predict future events because, often, quantification of security risk is difficult. Due to these uncertainties, companies will refrain from investing in such security tools. However, companies may modify this tool in specific reference to their needs instead of using the tool in a generalized manner.

b PulseNet

PFGE is a time consuming process and demands a high level of skills. The drawback is that the DNA fragments are separated not by their sequence but by their size. Same size fragments may represent different genomes. It is difficult to interpret differences in PFGE patterns. Certain strains cannot be identified by PFGE. The comparison of DNA patterns across all laboratories is possible only when standardized software is used by them. Protocol standardization and same molecular size standard is necessary for

maintaining uniformity in results. PGFE protocols for all organisms are not
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yet available for example, *Yersinia enterocolitica*, and *Enterobacter sakazakii*. PulseNet needs to strengthen collaboration for food safety with other stake holders that include food industry, non-profit national and international organizations, and academic institutions. PulseNet needs to not only improve but also develop simpler and faster subtyping methods (PulseNet International, 2013).

c Thermal Imaging

Thermal imaging has got significant boost in recent years due to its reliability, ease of operations and portability of equipment. There is no doubt that it has got tremendous applications in the food and agricultural sector. However, its performance is not free of certain environmental factors such as fog, wind, rain or sun, especially when applied to outdoor locations. As per Manickavasagan and Jayas (2007), in order to have accurate results, the emissivity of the objects needs to be high. Pre-treatment such as heating or cooling is necessary when put to use in post-harvest operations; moreover, pre-treatment varies depending upon applications. It means that its effective beneficial use largely depends upon a well-developed pretreatment method. Unlike other methods, thermal Imaging cannot have universal methodologies to apply in agriculture and food crops due to differences in thermal behavior. Different protocols are needed for different growing regions even for similar operations.

d Drones

Drones are extensively used by military officers, and as a result of this they are associated with loss of privacy. For their use to be effective, they have to be used extensively. They have also to be many in number in order to capture the view of large tracks of land. Thus, their installation and use will
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be very expensive.

e HACCP

HACCP are extensively used in identifying unintentional introduction of impurities into foods. Advancing their usage to that of monitoring and allocating impurities introduced into foods intentionally will not be that easy. They will require advancement and change of the methods used in identifying impurities introduced into foods unintentionally.

f FDPB

The success of FDPB software depends very much on the user's understanding of the software system. Although it proves to be one of the crucial ways of enhancing food security, it is evident that its usage may be prone with errors. The controller of the program may make some errors that are very detrimental to consumers of the foods produced.

Technological Advancement

Technological advancement is necessary to safeguard food systems completely from future terrorist risks. Only Governments can play a crucial role in developing systems and tools to detect pathogens in close liaison with the private sector institutions. Globally it is possible only when governments of most countries participate in this endeavor to safeguard food systems and develop procedures to ensure food safety without impeding the food supply. Private sector involvement is must for developing a safe and effective food supply systems across the nation. Private sector can contribute immensely in this process of ensuring food safety for all. The glaring example is the BAX detection system developed by DuPont in the US. The BAX system detects pathogens and other foreign material quickly and accurately not only in food samples but also in environment too. It focuses on breaking down samples at <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

the DNA level to detect pathogens or any other harmful material.

In the BAX system, samples are enriched as per the protocol prescribed for the food type. Sample under test is allowed to heat in a lysis reagent solution so that the bacterial cell wall gets ruptured and the DNA is released. PCR tablets containing all the reagents are hydrated with lysed sample in the detector. Finally, the polymerase chain reaction (PCR) inflates a DNA fragment. The inflated DNA emits a fluorescent signal that is analyzed by the BAX system application. It also displays results on monitor. The BAX system is capable of detecting 96 samples in each batch. The system is user friendly too because it guides one through the procedure without needing any extra skill to complete the procedure. Results are available within four hours once samples are ready. No expert knowledge is necessary to interpret the results (BAX System, 2014).

DuPonts RiboPrinter system is also worth mentioning that detects pathogens or microorganisms in food samples. The process is initiated by lysing cells; released DNA is cut into fragments using restriction enzyme. The fragments are separated according to size employing gel electrophoresis and taken on a membrane to hybridize with a DNA probe after mixing with a chemiluminescent agent. Light emission is captured by a digitizing camera to provide a RiboPrint pattern. The pattern gets compared with the database for identification. Results get printed automatically in a report form (RiboPrinter System, 2014).

It is pertinent to note that biochemical tests may misguide for Salmonella contamination but tests that take into account genetic information cannot fail. In one of the specific case, it was assumed that the meat-and-vegetable salads that the company produced and sold to tens and hundreds of vendors <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

were infected with Salmonella. When samples were tested using, latex agglutination, enzyme-linked immunosorbent assays (ELISA), biochemical screening they all gave positive results. However, when the samples were tested by the BAX, they displayed negative results for Salmonella. In order to further know about the kind of contamination, the samples were sent for testing on RiboPrinter Microbial system. When the system analyzed the sample and matched it with database, the contamination came out to be *Citrobacter freundii* and the company was saved off from recalling the material. The point is that such high-level of testing that deciphers genetic material can avert the major mishaps on food contamination issues during critical period of food terrorism (RiboPrinter Test, 2009).

This amply demonstrates that private sector can contribute immensely in developing a state-of-the-art and user-friendly technology that can detect microorganisms in a food sample within a short period of time and with accuracy.

Recommendations

Food processing systems need to be evaluated regularly for risk assessment to prevent any mishap from food terrorism regardless of the degree of risks involved and therefore, it is highly required that the CARVER+ tool is put to use in all food systems. The benefit is that they can also assess the possibility or the likelihood of a terrorist act. Along with they can also assess the likely impact and decide about the measures necessary to prevent or reduce its impact.

It is also strongly recommended that the government collaborates with the private sector for timely detection and speedier actions to mitigate the

effects. Collaborative approach will reduce the vulnerability of food

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terrorism. No individual companies or governments can deal with the threats of food terrorism alone; however, united efforts in public and private participation can track the activities effectively. Food supply chain involves numerous participants

Sheffi (2007) argues in favor of a resilient system that is capable of planning before the disruption occurs. He recommends for the companies to build flexibility in their entire supply chain balancing essential aspects such as taking security measures by discarding short-term profits. This reduces vulnerability from the unforeseen circumstances. Close collaboration and seamless communication with associates, partners, and government agencies including competitors can increase the resilience for any organization and helps to bounce back quickly after any disruptions or disasters. Communication at all levels and decentralized decision making can make the organization resilient.

Conclusion

Food security has always been a major concern across the world, especially after the incident of 9/11. It is being widely believed that risk of food terrorism is looming large in the current political and ideological divide. With a variety of food items changing hands across the countries and within the nation boundaries, the risk of food terrorism has increased several folds. Microbial food contamination is quite common affecting tens of thousands of people; however, deliberate attempts of food manipulation or poisoning can lead to catastrophic human losses and the US is extremely prone to such incidents. Incidents of food terrorism can derail the economy of affected country. Deploying advanced technologies and developing robust security system can check food terrorism to a great extent. Governments can do a lot <https://assignbuster.com/technology-the-solution-to-prevent-terrorism-in-the-us-food-system/>

by developing systems, processes and security protocol to thwart food terrorism; however, it is equally important that private organizations at local and national levels that include logistic providers, forensic experts, private laboratories, infectious disease specialists and many such agencies are not only involved but collaborate with each other to trounce any act of food terrorism.

While security system is essential, available technologies can play a pivotal role in detecting and identifying threats within a short period of time.

Unfortunate part is that terrorists too are getting them equipped with modern tools and devices posing a big challenge to mankind. What is required is to put in use all available relevant technologies depending upon the threat perceived. And this can succeed only when all small and large organizations realize importance of it and collaborate and communicate with each other eagerly.

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