Threat of bioterrorism on food safety and food security to Caribbean countries

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Abstract

The events of the September 11th 2001 terrorist attack in the United States along with food scares worldwide, have heightened the interest in protecting the Caribbean food supply chain, since it represents a tempting target for bioterrorists. Food terrorism could pose both severe public health and economic impacts. The best defense against food security threats is a real, proactive commitment to food safety. Food security and food safety share an integrated goal of 'prevention to protect' whether the threat/risk is intentional or accidental. Caribbean countries would need to consider a wider range of food security issues from their domestic production and look beyond their trading partners to assure food safety. This paper identifies some potential biological and chemical risks on food safety, steps that could be taken to enhance food security and the impact of the US Public Health Security and Bioterrorism Preparedness and Response Act of 2002 on food trade for Caribbean countries.

FOOD SECURITY

Food is a global commodity and nearly every country both exports and imports foods. The 1996, Caribbean Community and Common Market (CARICOM) Heads of State and Governments approved a declaration on food security in which Member States recognised that *'food security and nutritional well-being constituted the basic right of all our people, linked to the right of life, the lack of which threatens the sovereignty of States'*. The food security situation in the Caribbean countries stems from the increasing dependence on food imports, which have a direct impact on the balances of agricultural production, productivity and trade (FAO, 2003). The 1996 World Food Summit through the Rome Declaration on World Food Security and the World Food Summit Plan of Action, recognised the need to develop a concerted effort to ensure food security at the individual, household, national, regional and global levels (FAO, 2002).

The tragic event of September 11, 2001 in New York, USA has forever changed how the world will assess risk relative to deliberate contamination of the food supply and Caribbean countries must consider a much wider range of food security issues, security of their domestic production and look beyond its borders to their trading partners to assure food safety. The food supply is becoming increasingly diverse and vulnerable to both unintentional and intentional contaminants with dangerous foodborne contaminants. There are numerous points in the food chain that offer potentially easy targets for contamination, with the potentially catastrophic outbreaks. Agriculture and domestic food processing and distribution systems are vulnerable to acts of bioterrorism. A terrorist attack on the food supply could pose severe public health and economic impacts, while damaging the public's confidence in the food eaten (FDA, 2004). Hence, the term 'food security' refers to protection of food against both biological and chemical attacks.

WHAT IS BIOTERRORISM?

The intentional use of a variety of chemical and biological agents could be used in an attack on the food supply. For thousands of years, biological agents have been documented as instruments of warfare and terror (bioterrorism) to produce fear and harm in vulnerable populations. Recent world events have led to an increased awareness of the threat of bioterrorism through the use of biological agents including toxins. Bioterrorism is basically biological warfare, which is the intentional use of etiologic agents such as viruses, bacteria, fungi or toxins derived from living organisms to produce death or disease in humans, animals, or plants (Stern, 1999). It is the threatened release of biological agents for the purpose of influencing or coercing a civilian population (Robinson, 2002). These agents can be released through food as well as air, water, or insects. In 1984, there was actually a deliberate contamination of food with a biological agent that afflicted at least 751 people with foodborne illness. A religious cult, the Bhagwan Shree Rajneesh infected salad bars in an Oregon town with *Salmonella*, hoping to reduce voter turnout in

a local election so a candidate favorable to the cult would be elected (Riviere, 2002).

Potential bioterrorist agents

An agent is a term used to indicate a specific form of biological or chemical entity that could be employed in military environment (Riviere, 2002). Biological agents have not been difficult to acquire in the past and anyone with a rudimentary knowledge of microbiology could probably cultivate sufficient infectious doses to cause serious harm.

Table 1 lists the infectious agents and chemicals that have been previously used or postulated to be suitable for chemical warfare. In the assessment of a risk = hazard x exposure. A hazard may always be present, but because of low exposure, risk is minimal (Riviere, 2002). Table 2 shows a selection of biological pathogens and toxins that could potentially present a biosecurity problem. The diversity of foodborne pathogens continue to increase often making it difficult to determine the source of these pathogens and whether they are intentional or unintentional contaminant. Implementation of HACCP systems in the food industry has enhanced food safety of many foods, however, many foods still lack effective intervention strategies because the routes of contamination are unknown (Knabel, 2004). Do Caribbean countries have advance molecular tracking methods which are integrated into computer-based networks to enhance detection as in developed countries? No! According to Knabel, (2004), new molecular tracking methods would need to be more discriminatory, easier to use and have greater electronic portability.

Biological toxins

A toxin is defined as toxic material of biological origin that has been isolated from the parent organism; the toxic material of plants, animals, or microorganisms (Army Regulation 385-69, 1993). While the US military has experience working with biological toxins, an increasing number of civilian research laboratories have begun to use toxins as laboratory agents (Morin and Kozlovac, 2000). Current international agreement and treaties restrict the transport, use, and large-scale production of biological toxins. Biological toxins can include metabolites of living organisms, degradation products of dead organisms, and materials rendered toxic by the metabolic activity of microorganisms. Some microorganisms can be produced by bacterial or fungal fermentation, by the use of recombinant DNA technology, or by chemical synthesis of low molecular weight toxins. Toxins produced by bacteria are classified as either exotoxins or endotoxins. *Clostridium* spp including *C. tetani*, *C. botulinum*, and *C. perfringens* are all known to cause human disease as a direct result of exotoxin release during cell death. Endotoxin of gram-negative bacteria is derived from cell wall and is often liberated when the bacteria die and lyse.

Botulinum toxin as a bioterrorist agent

The biotoxin most suitable for dissemination in food is botulinum toxin, a natural agent of food poisoning produced by the anaerobic bacillus *Clostridium botulinum.* The ability to easily culture and produce botulinum toxin makes large-scale production by a determined terrorist, a simple proposition. Botulinum toxin of which there are seven

neurotoxins (types A-G) could attack the nervous system and may produce a fatal paralysis after ingestion of less than a millionth of a gram. Botulinum toxins may be aerosolized or used to sabotage food supplies. In 1980, the Paris police raided a house occupied by the terrorist group Red Army Faction and discovered botulinum toxin being cultivated in a bathtub (Riviere, 2002). Inhaled botulinum toxins produce a clinical picture similar to that of classic foodborne cases. Initial symptoms include generalized weakness, lassitude, and dizziness. Diminished salivation with extreme dryness of the mouth may contribute to a sore throat. The progression of the disease leads to more severe motor symptoms such as of blurred vision, diplopia, photophobia and dsyphonia (http://www.tdh.state.tx.us/bioterrorism/facts/bottox.html).

Chemical agents

Chemical agents are chemicals that are used in a military environment A commonly used 'stimulant' to study nerve agents is diispropylfluorophosphonate, an organo-phosphate insecticide too toxic for use as a pesticide but not toxic enough as a chemical warfare agent. In determining the safe levels of chemical exposure involves many phases of the process. One is an experimental determination of hazard that is based on well-defined and well-monitored animal studies. The aim of these experiments is to determine the 'no observed adverse effect level', the NOAEL (Riviere, 2002). Toxicology data are used to determine the maximum tolerated dose (MTD). To quantify both biological and environmental persistence of chemicals or pesticides, scientists and mathematicians have developed a concept of half-life ($T^1/_2$) to rank and compare very different drug and chemical classes. A half -life is defined as the length of time it takes a chemical to degrade to one half or 50% of its original does or amount applied (Riviere, 2002).

BIOTECHNOLOGY AND GENETIC ENGINEERING

Frightening scenarios could include the use of biological agents, which have been genetically engineered. Such modifications could include conferring antibiotic resistance to an agent such as an anthrax or increasing survivability of such agents when exposed to normal disinfectants or altered environmental conditions.

Genetically modified foods

There is an increasing awareness in some sectors of the population, of the global issues of food supply and the need to produce more food. However, there is an apparent conflict to de-intensify agriculture in order to provide more control and traceability over the foods that are consumed, in order to reduce the potential of environmental pollution and food contamination (Robertson, 2000). The future of genetically modified (GM) foods in Europe has been linked in the minds of the public to scares of the past. Unknown risks, apparent shortfalls in the regulatory processes and a cynical view that commercial gain is able to over-ride food safety regulatory controls, are all arguments used for adopting the 'precautionary principle' for GM foods (Robertson, 2000).

An Angus Reid World Poll surveyed 5,000 adult consumers about genetically modified foods in Australia, Brazil, Canada, France, Germany, Japan, United Kingdom, and United States (Angus Reid, 2000). Results from this international survey indicated that consumers around the world have a negative view about genetically modified foods and perceive the issue as one where the risks outweigh the benefits. Also, the context in which the consumers view the technology is more of a health and safety issue rather than progress in science and technology (Angus Reid, 2000). Studies have been conducted to assess the potential for transgenic plants to become more competitive in natural habitats (become pests) and to assess the potential for allergenic reactions and other adverse health effects in human beings who consume GM products (Bright *et al.*, 1996; Seidler *et al*, 1998).

GM Food legislation

In the safety assessment of GM food in Europe, GM food legislation is dominated by EC Regulation 258/97 on "Novel Foods and Ingredients.' This legislation (EC, 1997a) demands a formal process of pre-market approval that draws on the opinions of independent scientific committees in each Member State. In the USA, the Food and Drug Administration (FDA) holds the prime responsibility for GM food safety under the Federal Food, Drug and Cosmetic Act. The FDA policy on foods developed by biotechnology is outlined in a policy statement made in 1992 (FDA, 1992). A key principle is that an integrated stepwise and case by case approach is required. Safety assessment is aided by the use of decision trees that give guidance on the specific points that need to be addressed for an individual case. Substantial equivalence plays a key role in identifying differences between a GM food and its conventional counterpart. Table 3 shows an overview of GM food safety assessment. The information that is required for the safety assessment includes: details of the genetic modification; the stability of the modification and potential for its transfer; protein expression and its effect on function, allergy and toxicity; potential secondary effects; composition; intended uses and effects of cooking and processing; and potential intake and dietary impact (Gasson, 2002).

NEW LEGISLATION

New legislation would need to be enacted to strengthen the ability of Caribbean governments to respond to terrorist threats and new relationships must be forged between food security and law enforcement agencies.

The US Public Health Security and Bioterrorism Preparedness and Response Act of 2002 gives the Food and Drug Administration (FDA) new authority to protect its nation's food supply and strengthens the ability of the US government to respond to terrorist threats. The FDA had four major rules: Registration of Food Facilities; Prior Notice of Imported Food Shipments; Administrative Detention and Records Establishment and Maintenance on the Source of Raw Materials and Distribution of Products (FDA, 2004). The law empowers the government to detain foods that pose a risk (Zink *et al.* 2004). The proposals which

deal with food safety, deal with establishing and maintaining records among food firms, and the administrative detention of foods that may pose risk to public health. The two other proposals concern the registration of food facilities and prior notice of imported foods were published in January 2003. For more information see www.fda.gov/bbs/topics/NEWS/2003/NEW00902.html *or* www.fda.gov/oc/bioterrorism/bioact.html.; www.cfsan.fda.gov/~1rd/fr04441b.html regarding prior notice.

PREPAREDNESS IN THE CASE OF A REAL FOOD THREAT

Since the September 11, 2002 terrorist attacks, the U.S. Department of Agriculture (USDA) has hired new inspectors and strengthened its diagnostic capabilities around the country. The Food and Drug Administrative (FDA) bolstered food safety rules and made it easier for investigators to trace the origin of an outbreak. In the US, the Department of Homeland Security has assumed responsibility for the inspection of agricultural products entering the country, and individual states are working on their efforts to educate their citizens and ensure proper coordination in the event of an outbreak.

Preparedness of bioterrorism testing laboratories

Food and Drug Administration and the Centers for Disease Control and Prevention are working to expand the number of counter-terrorism laboratories capable of analysing foods. This broadened network will provide more efficient testing of food samples to help public health officials respond to chemical or biological terrorism incidents (Giese, 2003). For more information see www.fda.gov/oc/bioterrrorism/foodlab.html. Food samples will need to be submitted for toxin detection and or isolation of organism. A minimum 25g sample of each food to be tested for each pathogen is required. Food samples must be sent on cold packs rather than on wet or dry ice. Unopened suspect canned food samples can be sent at ambient temperature.

Mouse bioaassay is the most sensitive test to detect toxin in patient specimens. Survivors do not develop an antibody response due to the small amount of toxins necessary to cause death. *Clostridium* can be isolated from food or stool.

Emergency Response Agencies

In the US, the Federal Bureau of Investigation (FBI) has the lead responsibility for crisis management. The FBI anticipates, prevents, or resolves a threat or act of terrorist and has primary authority to prevent and respond to acts of terrorism. Do we have similar bodies in the Caribbean and are we prepared? In Trinidad and Tobago, National Emergency Management Agency (NEMA) seems to be our equivalent for managing the consequences, but, all too often in the past, they have been not fully prepared to handle routine emergencies.

AN APPROACH TO FOOD SAFETY AND FOOD SECURITY FOR CARIBBEAN COUNTRIES

The best defense against potential food security threats is a real, proactive commitment to food safety and security. A suitable approach should include the following:

Awareness - develop increased awareness among governmental and local agencies, private sectors and regional governments for collecting and disseminating information and knowledge. Need to have industry guidance documents on preventative measures in food security programs for food producers, processors, final transporters and retail food establishments. The participation of a number of interagency workgroups could foster better coordination and communication to improve food safety and security.

Prevention - develop the capacity for identification of a specific threat on the food supply. The need to find innovative ways to educate, train staff in the necessary scientific, technical and investigational skills to integrate food security and security activities. Laboratory staff would need to develop analytical methods for priority biological and chemical agents in foods and work with the Caribbean Epidemiology Centre (CAREC) to establish a Food Emergency Response- Network Emphasis must be placed on domestic preparedness by 'train the trainer programs' in for incidents such as emergency medical services, technicians, food inspection etc. National Agricultural Marketing Development Company (NAMDEVCO) in Trinidad and Tobago, West Indies, being the export body for fruits and vegetables has responded by instituting traceability on farms. Organisations such as the Caribbean Industrial Research Institute, Trinidad, West Indies, University of the West Indies, Chemistry, Food and Drugs Divisions in the Ministry of Health, have major roles in research, food safety intervention programs and educational training programs.

Preparedness - points of weaknesses must be identified in every segment of the domestic and imported food supply and appropriate protective measures taken. The threat assessments are important to direct and focus resources and to assist in the development of effective strategies to 'shield' the food supply from terrorist attack.

Recovery - develop capacity for rapid and coordinated recovery in the event of bioterrorism.

CONCLUSION

Ensuring the safety of the food supply is complex. Although a terrorist attack on agriculture and food is difficult to prevent, Caribbean countries must have the ability to respond to an attack and to limit the damage. There must be a clear recognition that government, academia, public health, industry, media, and consumers need to continue to work together to enhance food security. To respond to potential bioterrorism, food safety regulatory agencies need to be prepared to efficiently coordinate

their activities and respond quickly to public health. At the moment, the risks are great, as there has not been a strong coordinated effort by regional and local organizations. Although, there will be probably never be consensus on the level of risk associated with GM products, however public policies on biosafety will need to be in place that will govern how and when such products can be released for public consumption and who assumes the responsibility for any unanticipated consequences associated with their production and consumption.

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Table 1 - Biological and chemical agents relevant to bioterrorism

Infectious agents	-	Anthrax
	-	Plague
	-	Brucellosis
	-	Cholera
	-	Smallpox
	-	Viral haemorrhagic fever (Ebola, Marbug)
	-	Tularaemia
	-	Q fever
Biotoxins	-	Botulinum (Botulism)
	-	Ricin
	-	Staphylococcal enterotoxin B
	-	Mycotoxins (T-2 Nivalenol, Aflatoxin)
Chemical agents	-	Vesiccants (blistering forming: deadly both from inhalation exposure and dermal contact): Sulfur, Mustard (HD), Lewisite (L)
	-	Nerve Agents: Sarin (GB), Soman (GD), Tabun (GA)
	-	Phosgene (carbonyl chloride), Hydrogen cyanide, arsine, chlorine

Source: Riviere, 2004

Table 2 List of select biological pathogens and toxins

Viruses:	Ebola	Crimean-Congo haemorrhagic fever
	Smallpox	Tick-borne encephalitis
	Marburg	South American haemorrhagic fever
	Eastern equine encephalitis	Venezuelan equine encephalitis]
	River valley fever	Hanta virus
	Lassa fever	Yellow fever
	Equine morbillivirus	
Rickettssiae-	*Coxiell burnetti*	*Rickettsia ricketsii*
Fungi	*Rickettsia prowazekii*	*Coccidioides immitus*
Toxins	Abrin	Ricin
	Aflatoxins	Saxitoxin
	Botulinum	Shigatoxin
	Clostridium perfringens	Staphylococcal enterotoxins
	Epsilon	Tetrodotoxin
	Conotoxins	T-2 toxin
	Diacetoxyscipenol	T-2 toxin

Source - Centers for Disease Control (CDC) Riviere 2002

Table 3 Overview of GM food safety assessment

Major features of safety evaluation

- Use of an integrated stepwise and case - by- case approach
- Intended and unintended differences between GM and conventional counterpart identified using the substantial equivalence approach

Specific data required for:

- Details of genetic modification
- Stability of the modification and possibility of transfer of the modified genetic material
- Potential secondary effects of the genetic modification
- Composition of GM food or food ingredient
- Intended use and effects of processing or cooking
- Potential intake and dietary impact

Source: Gasson, 2002