

## 16.8: Green Chemistry to Combat Terrorism

Water to drink, food to eat, and air to breathe — the most basic of human needs — are likely targets for terrorist attack. The finding of a single cow with mad cow disease in Washington State in December, 2003, caused a major upheaval in cattle markets, loss of exports, and a final cost of perhaps hundreds of millions of dollars. Earlier outbreaks of mad cow disease and hoof and mouth disease in England had caused staggering economic loss. Mad cow disease is caused by a protein agent called a prion and can infect humans through contaminated meat causing fatal Creutzfeldt-Jakob disease characterized by devastating brain and nervous system effects. Over 200 cases of this malady linked to mad cow disease have been reported including a victim in Italy in 2010. Reported incidents of mad cow disease were the result of accident and poor agricultural and food production practices, not terrorism, but they illustrate the vulnerabilities of the food supply to potential terrorist attack.

A chemical attack on food supplies, though plausible, would be very difficult to carry out on a scale that would cause great damage. Spraying of food crops with toxic substances before harvest could cause some adverse effects and great anxiety, but would be relatively easy to detect and probably would not cause widespread harm.

Direct contamination of food with disease-causing agents is a possible terrorist action. An incident has been described in which 12 laboratory staff were infected by acute diarrheal illness that hospitalized 4 due to ingestion of *Shigella dysenteriae* bacteria taken from a culture in the laboratory and deliberately placed on doughnuts or muffins in the facility break room.<sup>4</sup> Most people have experienced the abdominal pain, vomiting, diarrhea and fever of “food poisoning” caused by *Salmonella* bacteria in contaminated food. Hundreds of millions of eggs infected by *Salmonella* in the U.S. during the summer of 2010 caused illness in several hundred people. Although rarely fatal, *Salmonella* on food have the potential to cause temporary disability.

Because of their central distribution to large numbers of people, water supplies are susceptible to both chemical and biological attack. There are reports of terrorist groups trying to obtain deadly cyanide salts with the objective of contaminating water supplies. The tragic arsenic contamination of water from tube wells unknowingly drilled into arsenic-bearing aquifers that may have afflicted as many as 77 million people in Bangladesh is a reminder of the potential for ill effects from chemical contamination of drinking water. Astoundingly toxic botulinus toxin from *Botulinus* bacteria (see Figure 16.2) is a potential chemical agent that could be put in water supplies. Though possible, it would be rather difficult to deliberately contaminate a municipal water supply with toxic chemicals.

Throughout history, drinking water contaminated by microorganisms that cause amebic, bacterial, and viral diarrhea; cholera; typhoid; and other maladies have killed millions and still cause disease and fatalities. The World Health Organization estimates that approximately 1.8 million people die each year from diarrhea and dysentery, much of which results from drinking contaminated water. In 1993, more than 400,000 people in Milwaukee were sickened and over 50 died from waterborne protozoal *Cryptosporidium parvum*. In May, 2000, approximately 3000 people were made ill and seven died in Walkerton, Ontario, Canada, from drinking water contaminated with *Escherichia coli* bacteria. Although usually *E. coli* bacteria are harmless and normal residents of human intestinal systems, they may develop strains with DNA transferred from *Shigella dysenteriae* bacteria that produce shiga toxin, the cause of potentially fatal dysentery, which is what happened in the Ontario incident. Bacteria that could be added deliberately to drinking water include *Shigella dysenteriae*, *Vibrio cholerae*, and *Yersinia pestis*.

Air is a possible medium for both chemical and biological attack. A means is required to deliver agents through the air, which makes it difficult to expose people through this medium. Although a low-flying crop-spraying plane would be an effective means of spreading either chemical or biological agents through the air, it would rapidly alert authorities leading to corrective action. Spores of bacteria that cause anthrax, *Bacillus anthracis*, are of particular concern for bioterror attack through air. Other microbial agents of concern for their potential for airborne attack include *Variola major*, which causes smallpox; *Francisella tularensis*, which causes tularemia, and viruses that cause viral hemorrhagic fevers, including Ebola, Marburg, Lassa, and Machupo.

Historically, the disease that has caused devastation most closely resembling the harm that could result from a massive attack by bio-agents is “plague,” which killed tens of millions of people in Europe during the Middle Ages. This malady is caused by infection with *Yersinia pestis* bacteria. This disease takes several forms, the most common of which is bubonic plague characterized by swollen, tender lymph glands called buboes. Readily cured by antibiotics in its early stages, it is transferred from infected rodents to humans by fleas, and several cases are reported each year in the Southwestern U.S. Pneumonic plague is readily spread through air between humans and is the form of most concern for terrorist attack. Initial symptoms similar to those of influenza progress to a fatal form of pneumonia.

This page titled [16.8: Green Chemistry to Combat Terrorism](#) is shared under a [CC BY-NC-SA 4.0](#) license and was authored, remixed, and/or curated by [Stanley E. Manahan](#).