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Ricin: Technical Background and Potential Role in Terrorism

Dana Shea

Analyst in Science and Technology Policy
Resources, Science, and Industry Division

Frank Gottron

Analyst in Science and Technology Policy
Resources, Science, and Industry Division

Summary

On February 2, 2004, the deadly toxin ricin was detected in the Dirksen Senate Office Building. Ricin, derived from castor beans, has been identified as a potential bioweapon. Ricin is extremely toxic by ingestion, inhalation, and injection. No treatment or prophylaxis currently exist, though research into new therapies and vaccines against ricin exposure continues. Additionally, research to improve ricin detectors is ongoing. Although the potential of ricin as a military weapon was investigated, it has predominantly been used in small quantities against specific individuals. Most experts believe that ricin would be difficult to use as a weapon of mass destruction, but do not discount its potential as a weapon of terror. Ricin is on the Select Agent list, and its possession, transfer, or use is regulated under domestic and international law. This report will not be updated.

Introduction

On February 2, 2004, the deadly toxin ricin was detected in Senator Frist's mailroom in the Dirksen Senate Office Building. It remains unclear how the toxin arrived there. All mail sent to government offices on Capitol Hill is sterilized by irradiation. However, this procedure was designed to kill bacteria, such as the causative agent of anthrax (*Bacillus anthracis*), not to inactivate preformed toxins such as ricin. Ricin is often mentioned as a potential bioterror weapon. This report describes what ricin is, how it is made, its effects, examples of its use, its potential for use as a bioterror weapon, and how it is currently regulated.

What Is Ricin?

Ricin is a potent plant toxin found in the seeds of the castor plant (*Ricinus communis*). It works by blocking cell protein synthesis, which results in cell death. This cell death can lead to organ failure and death.¹

How Is Ricin Obtained?

Ricin can be isolated from castor beans by several well known processes. During the industrial production of castor oil, bean mash with approximately 5 percent ricin content is produced. Several recipes for extracting ricin from castor beans are widely available on the Internet and from commercial bookstores. The quality of these directions ranges. Some directions would produce only crude preparations while others would produce nearly pure ricin.² Even the crude preparations have been considered deadly.³

Effects of Ricin

Persons exposed to ricin exhibit different symptoms depending on the route of exposure. Ingestion of ricin causes nausea, vomiting, diarrhea, gastric hemorrhaging, and shock. With a sufficient dose, death occurs within 3 to five days. Injection of ricin produces severe internal bleeding and tissue death, which can result in the collapse of major organ systems. Death often follows such a collapse. Inhalation of ricin irritates the lung linings and airways, leading to weakness and fever. Lesions may occur in the lungs causing tissue swelling and further damage.⁴

The lethal dosage of ricin depends on the route of exposure. Inhaled or injected doses as low as 3 to 5 micrograms per kilogram body weight may be lethal.⁵ This dose equals 240 to 400 micrograms for a 175 pound individual.⁶ Because ricin is less well absorbed in the gastrointestinal tract, the lethal dosage for ingestion is higher. Ricin is not active upon contact with intact skin.

¹ Jennifer Audi, *et al.*, "Ricin Poisoning: A Comprehensive Review," *Journal of the American Medical Association*, 2005, Vol. 294, pp. 2342-2351.

² The effectiveness of two well publicized methods was examined in René Pita, *et al.*, "Extraction of Ricin by Procedures Featured on Paramilitary Publications and Manuals Related to the Al Qaeda Terrorist Network," *Medicina Militar (España)*, Vol. 60, pp. 172-175.

³ In 1997, Thomas Leahy was convicted for possessing 0.7 grams of a powder that was approximately 4 percent ricin. Department of Justice officials stated that this was equal to 125 lethal doses of ricin. See W. Seth Carus, *Bioterrorism and Biocrimes: The Illicit Use of Biological Agents Since 1900*, (Washington, DC: Center for Counterproliferation Research, National Defense University) 2001, pp. 97-98.

⁴ See David R. Franz and Nancy K. Jaax, "Ricin Toxin," *Medical Aspects of Chemical and Biological Warfare*, (Washington, DC: Borden Institute, Walter Reed Army Medical Center) 1997, Chapter 32, pp. 631-642 and Jennifer Audi, *et al.*, *op cit.*

⁵ A microgram is equal to a millionth of a gram.

⁶ David R. Franz and Nancy K. Jaax, *op cit.*

Treatment for Ricin Exposure

Pre-exposure. No ricin vaccine is currently available for use by the general public. The Department of Defense has investigated vaccines in animal studies and submitted an Investigational New Drug (IND) application to the Food and Drug Administration for human safety testing. Research continues in the academic and private sectors to develop new vaccines. Additionally, animal studies suggest that passive prophylaxis, (i.e., injecting animals with antibodies obtained from other immunized animals), is effective against injected and ingested ricin. For inhaled ricin, the most effective prophylaxis appears to be through vaccination.⁷

Post-exposure. No medicine has been approved specifically to treat ricin exposure. The progressive nature of the toxin's effects requires hospitalization and continual supportive care. In cases of ingestion, treatment with activated charcoal is recommended to limit the ricin exposure. Stomach pumping may be considered if it can be performed within an hour of ingestion.⁸

Exposure Detection. Several methods are currently available to detect the release of ricin. Potential field detectors include automated air samplers that could detect the release of aerosolized ricin and swab-type tests that could signal the presence of ricin on surfaces. Highly sensitive laboratory-based tests can be performed on samples gathered on site.⁹ Since these detectors are generally not widely implemented in civilian settings, health care workers diagnosing ricin poisoning may be the first to detect a covert ricin attack. Both military and civilian sectors are developing faster, more sensitive detectors.

Examples of Ricin's Use

Ricin has been investigated as a weapon since the 1940s, when military programs investigated the feasibility of using bombs to disseminate aerosolized ricin. Such a weapon was reportedly developed by the United States and the United Kingdom, but never used.¹⁰ Iraq reportedly attempted to weaponize ricin in the 1980s.¹¹

In 1978, ricin was used to assassinate Bulgarian dissident Georgi Markov in London. A novel, umbrella-based weapon was used to inject a pellet containing ricin into Markov. Shortly after this episode, a similar pellet was discovered to be the source of illness of another Bulgarian exile, Vladimir Kostov.

In 1991, members of a tax-resistance group, the Minnesota Patriots Council, were found in possession of 0.7 grams of ricin-containing powder. They were arrested and

⁷ David R. Franz and Nancy K. Jaax, *op cit.*

⁸ Jennifer Audi, *et al.*, *op cit.*

⁹ Jennifer Audi, *et al.*, *op cit.* and *An Introduction to Biological Agent Detection Equipment for Emergency First Responders*, NIJ Guide 101-00, December, 2001.

¹⁰ David R. Franz and Nancy K. Jaax, *op cit.*

¹¹ Raymond Zilinskas, "Iraq's Biological Weapons: the Past as Future?" *Journal of the American Medical Association*, 1997, Vol. 278, pp. 418-424.

convicted for the possession of a lethal poison for use as a weapon, a violation of the Biological Weapons Anti-Terrorism Act (P.L. 101-298).¹²

In 1995, Thomas Lewis Lavy was arrested while crossing into Canada from Alaska. Canadian customs officials seized 130 grams of powder later determined to contain ricin.¹³ Mr. Lavy was later arrested for possession of a lethal poison for use as a weapon. His intentions for the ricin are unknown, as he committed suicide while in detention.¹⁴

In 1997, Thomas Leahy was arrested for shooting his stepson in the face. In the basement of Leahy's home was a makeshift laboratory where, tests indicated, he had produced ricin.¹⁵ Mr. Leahy pleaded guilty to violating the Biological Weapons Anti-Terrorism Act (P.L. 101-298) and was sentenced to more than six years in prison for possessing the ricin.

In 2002, Kenneth Olson was arrested for producing small amounts of ricin.¹⁶ He was found guilty of possession of a biological agent or toxin for use as a weapon, and sentenced to 13 years imprisonment.¹⁷

In January 2003, British law-enforcement arrested six men of North African origin following an intelligence tip. Police later found castor beans and manufacturing equipment in a north London apartment. Initial reports that traces of ricin were also recovered at this site were later proven false. Four of the suspects were subsequently acquitted. The fifth was sentenced to life in prison for murdering a police officer while resisting arrest and to 17 years in prison for "conspiracy to commit a public nuisance by the use of poisons or explosives."¹⁸

In October 2003, ricin was detected on an envelope processed in a Greenville, South Carolina mail facility. While no postal workers showed symptoms of ricin exposure, the facility was closed until environmental testing concluded that no facility contamination

¹² Jonathan B. Tucker and Jason Pate, "The Minnesota Patriots Council" in *Toxic Terror: Assessing Terrorist Use of Chemical and Biological Weapons*, Jonathan B. Tucker, Ed. (Cambridge, MA: MIT Press) 2000.

¹³ Richard Mostyn, "Stopped at Border, Man Carried Lethal Toxin," *Yukon Times*, February 23, 1996.

¹⁴ Statement for the Record of Robert M. Burnham, Chief, Domestic Terrorism Section, Federal Bureau of Investigation, before the United States House of Representatives Subcommittee on Oversight and Investigations, May 20, 1999.

¹⁵ *Ibid.*

¹⁶ Mike Barber, "Spokane Man Held on Poison Charge; Federal Authorities Say Father of Four Made Deadly Ricin in Plot to Kill His Wife," *Seattle Post-Intelligencer*, June 20, 2002.

¹⁷ Nicholas K. Geranios, "13-year Sentence Given in Ricin Trial," *Seattle Times*, October 29, 2003.

¹⁸ Severin Carrell and Raymond Whitaker, "Terror in the U.K. – Ricin, the Plot that Never Was," Police Hunt Deadly Poison," *Reuters*, April 17, 2005.

existed.¹⁹ The individual who mailed the ricin has not been identified. The Federal Bureau of Investigation has offered a \$100,000 reward for information leading to the individual's arrest.²⁰

In November 2003, the Secret Service reportedly intercepted an envelope containing ricin addressed to the White House. The letter accompanying the ricin shared similar demands as those found in the South Carolina letter.²¹

Additionally, trace amounts of ricin were reportedly found in various locales in Afghanistan,²² and an insurgent group in Iraq reportedly attempted to acquire ricin.²³

Ricin as a Weapon of Terror Rather than Mass Destruction

Many experts believe that ricin would be difficult to use as a weapon of mass destruction. Ricin needs to be injected, ingested, or inhaled by the victim to injure.²⁴ Biological weapons experts estimate that 8 metric tons would be required to cover a 100 km² area with enough toxin to kill 50% of the people. Thus, deploying ricin to cause mass casualties becomes logistically impractical even for a well-funded terrorist organization.²⁵ Furthermore, some experts have stated that the required preparatory steps to use ricin as a mass casualty weapon pose significant technical barriers that may preclude such use by non-state actors.²⁶

Although causing mass casualties would be difficult, most experts agree that ricin could be a formidable weapon if used in small-scale attacks.²⁷ The Centers for Disease Control and Prevention have listed ricin as a Category B Agent because it would be

¹⁹ Centers for Disease Control and Prevention, "Investigation of a Ricin-Containing Envelope at a Postal Facility – South Carolina, 2003," *Morbidity and Mortality Weekly Report*, Vol. 52, November 21, 2003, pp. 1129-1131.

²⁰ Jesse J. Holland, "FBI Offers Reward in Ricin-Package Case," *Washington Post*, January 8, 2004.

²¹ Dan Eggen, "Letter With Ricin Vial Sent to White House," *Washington Post*, February 4, 2004.

²² Jonathan Weisman, "Possible Anthrax Lab Unearthed Near Kandahar," *USA Today*, March 25, 2002.

²³ Charles Duelfer, Special Advisor to the Director of Central Intelligence, *Comprehensive Revised Report with Addendums on Iraq's Weapons of Mass Destruction*, (Washington, DC: Government Printing Office, September 2004), Vol. 1, p. 5.

²⁴ Some have suggested that ricin may be converted into a contact poison when combined with a solvent that can penetrate the skin. Reportedly, the Minnesota Patriots Council planned to use this delivery method. See Jonathan B. Tucker and Jason Pate, *op cit*.

²⁵ Mark Kortepeter and Gerald Parker, "Potential Biological Weapons Threats," *Emerging Infectious Diseases*, Vol. 5, No. 4, July-August 1999, pp. 523-527.

²⁶ Office of Technology Assessment, *Technologies Underlying Weapons of Mass Destruction*, OTA-BP-ISC-115, (Washington, DC: Government Printing Office, December 1993), p. 82.

²⁷ *Ibid*. For more on small-scale chemical and biological terrorist attacks, see CRS Report RL32391 *Small-scale Terrorist Attacks Using Chemical and Biological Agents: An Assessment Framework and Preliminary Comparisons* by Dana A. Shea and Frank Gottron.

moderately easy to disseminate and result in moderate morbidity rates and low mortality rates.²⁸ Although a string of attacks targeting dozens of victims at a time may not produce mass devastation, they might instill terror in the population, causing local economic disruption.

Current Regulation

Ricin is on the Department of Health and Human Services' Select Agent list (42 CFR 72) and possession, transfer, and use of ricin is restricted under the Public Health Security and Bioterrorism Preparedness Act of 2002 (P.L. 107-188).²⁹ Access to stores of ricin is limited to select bona fide researchers under the USA PATRIOT Act (P.L. 107-56). It is not illegal to possess or transfer castor beans, nor castor bean plants, because agents on the select agent list are exempt if they are in their natural state and no effort has been made to isolate the active agent (18 USC 175). Both castor beans and castor bean plants are openly sold within the United States, and castor bean plants grow naturally in the southwest.

The United States is a party to both the Biological Weapons Convention and the Chemical Weapons Convention. Ricin is a prohibited substance under both of these conventions. The Biological Weapons Convention bans the development, production, and stockpiling of biological agents or toxins for non-peaceful purposes. The Chemical Weapons Convention bans the development, production, stockpiling, transfer, and use of chemical weapons. The United States has entered into multilateral agreements to prevent the development of both chemical and biological weapons by other nations and terrorist groups.³⁰

²⁸ See Lisa Rotz, *et al.*, "Public Health Assessment of Potential Biological Terrorism Agents," *Emerging Infectious Disease*, Vol. 8, February 2002, pp. 225-230.

²⁹ For more information on laws and regulations related to potential biological terrorism agents, see CRS Report RL32220 *Biological and Chemical Weapons: Criminal Sanctions and Federal Regulations* by Michael John Garcia.

³⁰ For more information on this topic, see CRS Report RL31559 *Proliferation Control Regimes: Background and Status*, coordinated by Sharon A. Squassoni.