

## Technically Speaking

### Ricin

*by John Nordin, Ph.D.*

On February 2, 2004, a white powder was found in the mail room area of the Dirksen building where the Senate Majority Leader is located. Analyses of the material identified it as ricin, a lethal plant protein. No one became ill, but three Senate office buildings were closed.

Let us take a look at this lethal poison.

#### PEAC Tool

In the PEAC tool, Ricin falls under the general heading of "Bio Toxins" using the menu selection, "Lookup By:" The following information is displayed under ricin:

#### Ricin

##### GUIDE 153 Substances - Toxic and/or Corrosive (Combustible)

White powder, a very toxic lectin and hemagglutinin isolated from the castor bean. When weaponized, exposure likely through inhalation of a toxin aerosol.

Ricin is a cytotoxin (causes cellular destruction). LD(50) approx. 3 micrograms/kg. Routes are inhalation, ingestion, and injection. Has been used as an assassination weapon.

CAS NO: 9009-86-3

TEEL1: 0.075 mg/m<sup>3</sup>

TEEL2: 0.5 mg/m<sup>3</sup>

TEEL3: 1.5 mg/m<sup>3</sup>

Guide 153 refers to the 2000 Emergency Response Guidebook. The PEAC user can pull up further instructions on health hazards, public safety, protective clothing, evacuation, first aid, and fires pertaining to this guide number.

"LD(50) approximately 3 micrograms/kg" means that the lethal dose (50% chance of death) is approximately 3 micrograms per kilogram of body weight. A 210 microgram dose can kill a 70 kg (155 lb) man. A 210 microgram dose is very small, a little smaller than the size of a pinhead. The U.S. Center for Disease Control says 500 micrograms of ricin can kill an adult, but the amount required to kill depends upon whether ricin is injected, inhaled, or ingested.

"TEEL1, TEEL2, and TEEL3" are acronyms for "Temporary Emergency Exposure Limit", levels 1, 2, and 3. The units are "milligrams per cubic meter" and represent concentrations in the air. They were developed by the U.S. Dept. of Energy to serve as temporary numbers until the peer-reviewed Emergency Response Planning Guidelines (ERPG) are published. Details on TEELs may be found at the website,

<http://www.bnl.gov/scapa/TEELs%20Journal%20of%20App%20Tox.pdf>

The CAS NO is a unique number assigned by the American Chemical Society for ricin. CAS is an acronym for Chemical Abstract Services; it is used as an index number to aid researchers in locating information about specific chemicals.

The words "has been used as an assassination weapon" refer to a 1978 incident. George Markov, a Bulgarian journalist living in London, died after he was attacked by a man with an umbrella which was rigged to inject a ricin pellet under Markov's skin.

### Physical Characteristics of Ricin

Ricin is a poison made from castor beans. Castor beans are grown worldwide and are readily available. Castor beans are normally used to make castor oil. Ricin is part of the waste mash produced after extraction of castor oil. If purified and dried, ricin is an odorless, white powder. Ricin can also be in the form of pellets or dissolved in water or weak acids such as vinegar or dilute phosphoric acid or dilute alcohol. Ricin can be stored for years and is unaffected by very hot or cold temperatures. Crude ricin may be buff or otherwise colored. It can be weaponized and dispersed as a mist.

### How Can People Be Exposed to Ricin

It takes a deliberate act to make ricin and use it to poison people. Accidental exposure to ricin is unlikely. Ricin poisoning is not contagious; it cannot be spread from person to person through casual contact. Skin contact is harmless if there are no cuts in the skin. Ricin may have some potential medical uses such as in bone marrow transplants and treatment of cancer, according to the Center for Disease Control (under the U.S. Dept of Health and Human Services).

Exposure routes are inhalation, injection, or ingestion. People can inhale ricin powder or mist. Ricin can be put into the food or water supply. An amount greater than 200 or 500 micrograms is required to kill a person if swallowed compared with direct injection or inhalation. Ricin is not very well absorbed through the gastrointestinal tract. People have also been poisoned from eating castor beans. Most of what we know on inhalation is from animal studies.

There is no antidote for ricin poisoning. The most important factor is to avoid exposure in the first place.

### Symptoms of Ricin Poisoning

Ricin works by preventing the person's body cells from making protein. Symptoms depend upon whether ricin is inhaled or ingested. A person displaying these symptoms does not necessarily mean that the person has been exposed to ricin.

Inhalation: Respiratory distress (difficulty breathing) symptoms appear within about 12 hours (within a few hours after inhaling significant amounts of ricin). Other symptoms are fever, cough, nausea, fatigue, and tightness in the chest. Heavy sweating may follow as well as pulmonary edema (fluid buildup in the lungs). Fluid buildup in the lungs makes breathing even more difficult, and the skin may turn bluish. Finally, low blood pressure and respiratory failure may occur.

Ingestion: If significant amount of ricin is ingested, symptoms are vomiting and diarrhea (diarrhea may be bloody). Severe dehydration may result followed by low blood pressure. There may be hallucinations, seizures, muscle pain, and blood in the urine. Within several days, the person's liver, kidneys, and other vital organs may stop working and the person dies.

Skin or Eye Contact: Ricin in powder or mist form can cause redness and pain especially to the eyes.

If death has not occurred within 5 days, the person usually recovers.

#### Differential Diagnosis

Exposure to certain other toxic chemical or biological agents can produce similar symptoms. These include but are not necessarily limited to

Inhalation: Staphylococcal enterotoxin B; exposure to pyrolysis byproducts of organofluorines such as Teflon or Kevlar; oxides of nitrogen, and phosgene.

Ingestion: Enteric pathogens, poisonous mushrooms, caustics, iron, arsenic, colchicines

Abrin is another very toxic bio toxin derived from seeds of a different plant which produces similar symptoms. Treatment for Ricin Poisoning

No antidote exists for ricin poisoning. According to the Center for Disease Control, there is no definitive test to determine whether a person has been poisoned by ricin. Medical treatment is: (1) supportive and (2) getting the ricin off or out of the body as quickly as possible. Getting the ricin off or out of the body means: (1) removing contaminated clothing, washing the skin, and flushing the eyes with water if contacted with dust or mist, or (2) flushing the stomach with activated charcoal if ricin was very recently ingested. Supportive treatment include measures to help patients breath, giving intravenous fluids, and giving medications to treat conditions such as seizures or low blood pressure.

#### Emergency Response and First Aid

The U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, recommends the following in a Feb. 5, 2004 website release:

- First, get fresh air by leaving the area where the ricin was released. Moving to an area with fresh air is a good way to reduce the possibility of death from exposure to ricin.
  - If the ricin release was outside, move away from the area where the ricin was released.
  - If the ricin release was indoors, get out of the building.
- If you are near a release of ricin, emergency coordinators may tell you to either evacuate the area or to "shelter in place" inside a building to avoid being exposed to the chemical. For more information on evacuation during a chemical emergency,

see [Facts About Evacuation](#). For more information on sheltering in place during a chemical emergency, see [Facts About Sheltering in Place](#)

If you think you may have been exposed to ricin, you should remove your clothing, rapidly wash your entire body with soap and water, and get medical care as quickly as possible.

- *Removing your clothing:*
  - Quickly take off clothing that may have ricin on it. Any clothing that has to be pulled over the head should be cut off the body instead of pulled over the head.
  - If you are helping other people remove their clothing, try to avoid touching any contaminated areas, and remove the clothing as quickly as possible.
- *Washing yourself:*
  - As quickly as possible, wash any ricin from your skin with large amounts of soap and water. Washing with soap and water will help protect people from any chemicals on their bodies.
  - If your eyes are burning or your vision is blurred, rinse your eyes with plain water for 10 to 15 minutes. If you wear contacts, remove them and put them with the contaminated clothing. Do not put the contacts back in your eyes (even if they are not disposable contacts). If you wear eyeglasses, wash them with soap and water. You can put your eyeglasses back on after you wash them.
- *Disposing of your clothes:*
  - After you have washed yourself, place your clothing inside a plastic bag. Avoid touching contaminated areas of the clothing. If you can't avoid touching contaminated areas, or you aren't sure where the contaminated areas are, wear rubber gloves, turn the bag inside out and use it to pick up the clothing, or put the clothing in the bag using tongs, tool handles, sticks, or similar objects. Anything that touches the contaminated clothing should also be placed in the bag. If you wear contacts, put them in the plastic bag, too.
  - Seal the bag, and then seal that bag inside another plastic bag. Disposing of your clothing in this way will help protect you and other people from any chemicals that might be on your clothes.
  - When the local or state health department or emergency personnel arrive, tell them what you did with your clothes. The health department or emergency personnel will arrange for further disposal. Do not handle the plastic bags yourself.

- For more information about cleaning your body and disposing of your clothes after a chemical release, see [Chemical Agents: Facts About Personal Cleaning and Disposal of Contaminated Clothing](#), .
- If someone has ingested ricin, do not induce vomiting or give fluids to drink.
- Seek medical attention right away.

#### Identification of Ricin

Field identification of ricin is possible if specialized tools are available and people are trained to use them. These include a handheld chromatographic antibody-based assay plates (an enzyme-linked immunosorbent assay, or ELISA) to get preliminary readings. The plates are sensitive and generally do not produce false readings. Laboratories generally use a more exacting ELISA procedure. The Maryland Public Health Laboratory used an ELISA procedure using time-resolved fluorescence immunoassay to test 65 samples taken from the postal facility serving Capitol Hill for ricin [from *Chemical and Engineering News*, Feb 9, 2004, page 11].

More information on laboratory testing can be found at the website,

<http://www.bt.cdc.gov/agent/ricin/labtesting.asp>.