



Biological Toxins

General Guidance

Purpose

This document was created with the intent of providing general guidance on the use of biological toxins. It is the PIs responsibility to train laboratory personnel on the individual agents and on the specific research techniques.

All laboratories performing experiments with such toxins must have an updated Chemical Hygiene Plan. For a template of this plan, go to

<https://ehs.uc.edu/Forms/UC-CHP.pdf>

Definition

Biological toxins or biotoxins are toxic substances that can be produced by bacteria, fungi, protozoa, animals, or plants and are classified separately from chemical toxins. They are non-replicative, noninfectious materials but can be extremely hazardous, even in minute quantities.

Researchers must be trained in the theory and practice of the biotoxins to be used, with special emphasis on the nature of the practical hazards associated with laboratory operations. This includes how to handle transfers of liquids containing toxin, where to place waste solutions and contaminated materials or equipment, and how to decontaminate work areas after routine operations, as well as after accidental spills.

Route of Exposure & Health Effects

Individuals can be exposed to biotoxins by the respiratory, oral and percutaneous routes. Also, other possible routes are the direct contact of biotoxins with mucosa (e.g. eyes, nose) and even with intact skin (e.g. T2 mycotoxin).

The health effects of exposure can vary greatly depending on the toxin type, the amount of toxin and the route of exposure, ranging from minor (skin or eye irritation, headache, nausea) to severe (respiratory

distress, muscle weakness, seizures, death).

Researchers must be familiar with the target organs for the biotoxin in use and with the signs/symptoms of intoxication. For information on individual toxins, go to the [Toxin and Toxin-target database](#).

Containment Level

Experiments involving biotoxins are to be conducted under BSL2 conditions (facilities and practices).

Hazard Communication

Research activities with biotoxins should be done only in designated rooms with controlled access. When toxins are in use, the room should have a door sign to indicate that toxin work is in progress and that the area is restricted to authorized personnel.

When toxins are stored in the lab, containers should be sealed, legibly labeled and secured to ensure restricted access.

Inhalation Exposure

Inhalation of toxin may occur during manipulation of dry products.

- Whenever possible, purchase toxins in liquid form.
- If a dry toxin needs to be re-suspended, use a ventilated enclosure such as a biological safety cabinet (BSC – a.k.a. tissue culture hood) or a chemical fume hood.
- Give preference to premeasured products which allow addition of the diluent without the need of opening the vial.
- Materials inside the BSC or chemical fume hood must be limited to what is necessary for resuspension of the dry toxin. All other materials and equipment must be removed.
- Place plastic-backed absorbent paper (bench diaper) on the work surface of the BSC or chemical fume hood.
- Vials should be maintained in a closed secondary container that will not allow escape of the product in container is dropped.
- Toxins should only be removed from the BSC or chemical fume hood after the exterior of the closed primary container has been decontaminated (with a solution appropriate for specific toxin) and placed in a clean secondary container.

- Until thoroughly decontaminated, the BSC or chemical fume hood should have a sign to indicate that toxins remain in use, and access should remain restricted.
- “Static-free” disposable gloves should be worn when working with dry forms of toxins that are subject to spread by electrostatic dispersal. *Spraying static guard on gloves is recommended. Two examples are Kensington Dust Guardian® Antistatic Spray Cleaner and KleenMaster Brilliantize Cleaner and Polish.*
- Remove gloves after handling powdered toxin carefully avoiding skin contact with the exterior surface of the gloves. Wash hands thoroughly.

Percutaneous Exposure

Accidental injection and cuts while handling sharps are potential risks for exposure.

- Avoid sharps whenever possible.
- Always consider the use of a safety engineered device, such as retracting needles.
- If a syringe and needle are used to add liquid to resuspend a dry toxin, immediately dispose of the needle and syringe into a sharp container. Needles should not be used for dispensing or aliquoting the toxin in solution.

Percutaneous Exposure Contin.

- Only workers trained and experienced in handling animals and restraint methods should be permitted to conduct operations involving injection of toxin solutions using hollow-bore needles.
- Thin-walled glass materials should be completely avoided. Glass Pasteur pipettes are particularly dangerous for transferring toxin solutions and should be replaced with disposable plastic pipettes.

Ingestion & Mucosal Contact

Splash of liquid toxin and direct contact with contaminated object(s) can be subsequently spread to mucus membranes.

- Always wash hand after removing PPE and before leaving the lab.

Toxin Inactivation

Inactivation method depends on the chemical composition of the biotoxin. Toxin stability varies considerably outside of physiological conditions depending upon the temperature, pH, ionic strength, and other characteristics.

Most proteinaceous biotoxins (e.g. staphylococcus enterotoxin, ricin, cholera toxin), can be effectively inactivated by exposure to 10% bleach for at least one hour or by autoclaving at 121°C and 15 psi for one hour. Some proteinaceous toxins, however, can re-fold and partially reverse inactivation caused by heating.

Inactivating non-proteinaceous biotoxins (e.g. T-2 toxin, conotoxins, and tetrodotoxin) is less straightforward and need a combination of sodium hypochlorite and sodium hydroxide.

Personal protective Equipment (PPE)

- Laboratory personnel working with biotoxins should wear proper PPE to protect skin, clothing and mucosa:
- Lab coat or back-closing disposable gown - button lab coat to the top and give preference those with knit or grip cuffs, or use gloves that are long enough to cover the sleeves. Sleeve covers offer additional protection
- Disposable gloves – the use of double gloves is strongly recommended. Ensure that your gloves are compatible with any solvent your toxin may be dissolved in.
- Full face protection (face shield or goggles and face mask) is recommended, but not required when restricting work to a biosafety cabinet or a chemical fume hood.

Exposure Prophylaxis

Researchers working with biotoxins should be vaccinated if a vaccine is available (e.g. diphtheria toxin, tetanus toxin).

Exposure Response

Immediate response and medical “first-aid” interventions may help prevent or lessen the severity of the intoxication. If you know or suspect that a biological toxin exposure occurred:

- Irrigate the site of exposure
- If exposure was by needle stick or other route which breaks the skin, wash with soap and water for 5-15 minutes and cover with a bandage.
- If exposure was by splash to eyes or mucus membranes, irrigate thoroughly for 15 minutes at an appropriate eye wash station.
- Contact the Drug and Poison Information Center (DPIC) IMMEDIATELY at 513-636-5111. This center has a toxicologist on call 24 hours per day, 7 days per week who will provide instructions on proper decontamination as well as coordinate a clinical evaluation with the University Hospital Emergency Department.
- Report the incident to your laboratory supervisor who should follow the [work-related illness/injury policy](#).

BIOTOXINS

Regulated Toxins

There are specific regulatory requirements for working with toxins designated as “Select Agents”. Possession, use, storage and/or transfer Select Agents at the University of Cincinnati require registration with the USDA. Go to the [Select Agents section](#) for more information.