## Standard Operating Procedure

# **BIOLOGICAL TOXIN: \_\_\_\_\_\_\_\_**

## Overview

Biological toxins are toxic substances produced by living organisms which may take the form of small molecules, peptides, or macromolecular proteins. Biological toxins are classified separately from chemical hazards, although the effects of intoxication are analogous to symptoms of exposure to toxic chemicals. Biological toxins have been optimized to disrupt critical biological processes at low concentrations, and exposure may cause death or severe incapacitation even after relatively low exposure levels. Toxicity may be characterized as cytotoxic, neurotoxic, hemolytic, or necrotic.

* *Biological toxins* are substances that may be fatal as a result of a single exposure (LD50 << 50 mg/kg (oral), 200 mg/kg (dermal), 500 ppm (inhaled).

Biological toxins may be transmitted via inhalation of powders, aerosols or volatile substances; ingestion; absorption through dermal, mucosal or ocular tissues; percutaneous incidents/injection. Some biological toxins can be absorbed through intact skin, especially if solubilized in substances like dimethyl sulfoxide.

This SOP is intended for purified biological toxins, and not for cultures of microorganisms producing biological toxins. In addition to the section for Laboratory Specific Information, there is a second section requiring customization on Toxin Specific Information. Information on general handling precautions and specific toxins may also be found in [Biosafety in Microbiological and Biomedical Laboratories](https://www.cdc.gov/labs/BMBL.html) (BMBL), current edition. Contact the biosafety officer at EHS for assistance customizing this template, and/or consult the BMBL, safety data sheets, and the primary literature for information on the specific biological toxin.

## Special Handling and Storage Concerns

**Storage equipment, location and security**

Toxins should be stored in storage containers with labels that clearly list the toxin contents, points of contact for trained, responsible laboratory staff, and emergency contact information.

The use of locks on storage containers offers an additional level of oversight and control over toxin access.

**Select Toxins**

Select Toxins Registration with the CDC or USDA is required for possession, use, modification, production, storage, and/or transfer of non-exempt quantities of Select Toxins, while exempt quantities should be carefully managed by the responsible organization to prevent loss or misuse.

|  |  |
| --- | --- |
| [Permissible Select Toxin Amounts](https://www.selectagents.gov/sat/permissible.htm) | **Amount** |
| Abrin | 1000 mg |
| Botulinum neurotoxins | 1 mg |
| Short, paralytic alpha conotoxins | 100 mg |
| Diacetoxyscirpenol (DAS) | 10,000 mg |
| Ricin | 1000 mg |
| Saxitoxin | 500 mg |
| Staphylococcal Enterotoxins (Subtypes A, B, C, D, and E) | 100 mg |
| T-2 toxin | 10,000 mg |
| Tetrodotoxin | 500 mg |

**Engineering controls**

* Dry toxin must be manipulated using containment such as a disposable glove bag, chemical fume hood or a biosafety cabinet.
* Use a biosafety cabinet or a chemical fume hood for resuspending biological toxins or for manipulations that can generate aerosols, e.g., pipetting, aliquoting, and opening sealed centrifuge safety cups.

**Handling Practices**

* Biosafety level 2 practices and facilities are used for activities involving biological toxins.
* Bench areas designated for work with biological toxins may be delineated with plastic-backed, absorbent pads.
* Biohazard signs and labels must be displayed in areas and on equipment where biological toxins are used and stored. This includes, but is not limited to, laboratory entrance doors, biosafety cabinets, chemical fume hoods, refrigerators, and freezers.
* When biological toxins are in use, the room should be clearly posted:   
  “Toxins in Use—Authorized Personnel Only.”
* Experiments should be planned to eliminate or minimize work with dry, powdered toxin.
* Some toxins arrive in lyophilized or powder form in rubber septum sealed vials; a needle is inserted through the septum to resuspend the toxin, without the need to open the vial containing the dry form of toxin.
* Evaluate and modify experimental procedures to reduce the potential for aerosols and droplets of solutions containing toxin.
* Researchers should be adept at the experimental procedures before working with the biological toxin. For complex operations, researchers may want to perform practice runs in which the procedures are rehearsed without active toxin.
* Consideration should be given to requiring the presence of at least two knowledgeable individuals at all times in the laboratory for high-risk operations:
* Manipulations with dry forms of toxins
* Intentional aerosol formation
* Use of hollow-bore needles or glass pipettes in conjunction with amounts of toxin estimated to be lethal for humans

**Precautions for Work in Animals**

* The Animal Biosafety Level (ABSL) designation will be determined by the Institutional Biosafety Committee during project review. ABSL-1 handling and containment is usually sufficient for *in* *vivo* projects with biological toxins.
* You will need to establish an Animal Facility Safety Hygiene Plan that is specific to the biological toxin before introducing it into the Animal Resource Center.

**Personal Protective Equipment**

* Liquid impervious cuffed lab coat.
* Consult a glove chart based on the solvents used with the toxin.   
  Glove selection is important when working with DMSO. Nitrile gloves protect from brief contact but degrade with exposure to DMSO. Butyl rubber, neoprene, or thick (15 mil) latex gloves are recommended.
* ANSI Z87.1-compliant safety glasses
* Eye protection (safety glasses or goggles) is recommended, but not required when working within a biosafety cabinet or a chemical fume hood

**Decontamination**

Toxin stability varies considerably outside of physiological conditions depending upon the temperature, pH, ionic strength, and other characteristics. Inactivation is not always a linear function of heating time, and some protein toxins possess a capacity to re-fold, and partially reverse inactivation caused by heating. In addition, the conditions for denaturizing toxins in aqueous solutions are not necessarily applicable for inactivating dry, powdered toxin preparations.

Consult the BMBL, safety data sheets, and the primary literature to identify effective decontamination procedures and disinfectants.

## Waste Management

**Deactivation methods**

Contaminated materials and toxin waste solutions can be inactivated by incineration, extensive autoclaving, or by soaking in a suitable decontamination solution, depending on the toxin.

Consult the BMBL, safety data sheets, and the primary literature for effective deactivation procedures.

## First Aid and Emergencies

**Spill**

If you are not working over a plastic-backed absorbent pad, cover the liquid first with paper towels, then apply fresh disinfectant.

Consult the BMBL, safety data sheets, and the primary literature for effective decontamination procedures and disinfectants.

**Fire**

Standard measures apply.

**Personnel Exposure**

*Sharps incident:* Wash with soap and water for 15 minutes and cover with a bandage.

*Mucous membrane or eye contact*: Flush affected area with water for 15 minutes at an eyewash station. *Inhalation:* Move person to fresh air.

*Ingestion:* Rinse mouth with water.

After flushing affected areas, report the exposure to your Laboratory Supervisor and seek medical attention immediately.

## Laboratory Specific Information

**Prior Approval Required**

**NO**

**YES (describe):**

The Institutional Biosafety Committee reviews Biological Use Authorizations for work with toxins on the Select Agents and Toxins list, as well as biological toxins with an LD50 ≤ 100 µg/kg.

**Area(s) Designated for Work**

* Work with toxins should only be done only in laboratories with controlled access and at pre-determined bench areas.

**Experimental Conditions of Use**

**Maximum amount of toxin to acquire:**

**Procedures with dry toxin:**

**Concentrations of stock solutions:**

**Concentrations of working solutions:**

**Experimental procedures:**

**Other:**

## Toxin Specific Information

**Toxin activity and symptoms of intoxication:**

**Availability of vaccine or antitoxin:**

**Toxin lethal dose 50% along with the route(s) of administration and the model(s) used:**

**Toxin environmental stability:**

**Waste disposal procedures:**