Status: Currently Official on 12-Feb-2025
Official Date: Official as of 01-Dec-2019
Document Type: General Chapter
DocId: GUID-E188A886-187E-45DE-B4AD-D34F3B86864E_2_en-US
DOI: https://doi.org/10.31003/USPNF_M12456_02_01
DOI Ref: dre3f

Add the following:

▲〈1229.16〉 PRION INACTIVATION

INTRODUCTION

Prions are transmissible agents comprised of abnormal proteinaceous materials that lead to the precipitation of healthy protein within eukaryotic cells, leading to cell death. Prions have been associated with transmissible spongiform encephalopathies (TSE), fatal neurological diseases, that occur in humans and other animals. Some examples of TSE are Creutzfeldt-Jakob disease (CJD) in humans, scrapie in sheep, and bovine spongiform encephalopathy (BSE) in cattle. Prions are considered highly resistant to most physical and chemical destruction agents, and in many cases are more resistant than bacterial spores to these agents (*1*). Prions are potential contaminants in materials and cell lines of mammalian origin and their inactivation/removal is required where their presence can be expected. They can also be found on equipment and medical devices exposed to contaminated materials. Empirical confirmation is recommended in the application of all prion inactivation processes as there are different contaminants, conflicting statements regarding performance, and limited information on many of the potential processes.

The removal of proteinaceous materials including prions is made more difficult if these are allowed to dry on surfaces before treatment. For that reason all surfaces should be kept water wet until inactivation begins.

The process conditions and agents used for prion inactivation must consider patient safety as part of the risk assessment during product manufacture and reprocessing of equipment and medical devices. The effect of the process/agent on the materials being processed must be considered.

When the items/materials to be treated are intended for disposal, incineration is considered to be the most effective means of prion inactivation.

METHODS OF DESTRUCTION

Chemical Methods

Physical removal and prion degradation (or fragmentation) have been demonstrated using a variety of alkaline cleaning formulations, typically at pH >9. The usefulness of these harsh solutions varies considerably depending on the formulation, concentration, pH, and cleaning process conditions (e.g., exposure time, temperature). Reported results regarding the chemical inactivation of prions have been inconsistent because of numerous variables involving the prion (e.g., strain, concentration, underlying tissue, test species) and the chemical treatment (e.g., agent, concentration, process parameters). Effective prion-inactivating chemical agents include chlorine (delivered in various forms), phenolic compounds, guanidine thiocyanate, and sodium hydroxide, among others (*2*). Chemical methods (with or without heat) are better suited for surface treatment.

Thermal Methods

The destruction of prions by moist heat has been reported across a wide range of temperatures (from 100°/15 min to 138°/1 h), which reflects the diversity of the challenge presented (*2*). Thermal treatments can be used for raw materials, fluids, and equipment.

Combination Methods

The combination of chemical and thermal methods provides the greatest confidence in prion titer reduction for equipment. A common process for prion decontamination is moist heat (or superheating under pressure) over time (e.g., 121° for ≥1 h, 132°–136° for ≥18 min) immersed in concentrated alkaline solutions such as sodium hydroxide (NaOH) at 1–2 N. Lower concentrations of sodium hydroxide and potassium hydroxide have been shown to be effective against surface prion contamination when used in combination with surfactants supplemented with other chemical additives. An example is a disinfectant formulation containing 0.2% sodium dodecyl sulfate (SDS), 0.3% sodium hydroxide, and 20% *n*-propanol; this combination has been shown to be effective against prions, bacteria, and viruses. The effects of alkali and steam sterilization on prions have been studied and shown to cause protein and peptide fragmentation over time; these effects can be enhanced at increased concentrations of the alkali solution and/or higher temperatures (*1*). When working with hazardous chemical methods, there are practical problems that need to be considered, such as risks to personnel while handling harsh chemical agents, the eventual deleterious effects on the autoclave chamber, and the potential detrimental effects on medical devices due to surface reactive damage to metals and plastics. In addition to sodium hydroxide, sodium hypochlorite (chlorine) solutions are widely used as anti-prion chemicals (*3*).

METHODS THAT ARE NOT EFFECTIVE

The following disinfectants or disinfection processes have been shown to be ineffective for prion decontamination: formaldehyde, glutaraldehyde, alcohols, radiation (ionizing or nonionizing), dry heat, ethylene oxide, quaternary ammonium compounds, pasteurization, and boiling (*4*).

REFERENCES

1. Rutala W, Weber D. Creutzfeldt-Jakob disease: Recommendations for disinfection and sterilization. *Clin Infect Dis.* 2001;32(9):1348–1356.
2. McDonnell GE. Mechanisms of microbial resistance. In: *Antisepsis, Disinfection, and Sterilization: Types, Action, and Resistance.* 2nd ed. Sterling, VA:ASM Press;2017:285–393.
3. McDonnell GE. Transmissible spongiform encephalopathies and decontamination. In: Fraise AP, Maillard J, Sattar SA, eds. *Principles and Practice of Disinfection, Preservation, and Sterilization.* 5th ed. Hoboken, NJ:Wiley-Blackwell;2012:208–228.
4. McDonnell GE. Decontamination of prions. In: Walker JH, ed. *Decontamination in Hospitals and Healthcare.* Cambridge, UK: Woodhead Publishing;2014:346–369.
5. CDC recommendations for decontamination of instruments contaminated with prions (https://www.cdc.gov/prions/cjd/infection-control.html).
6. WHO Infection Control Guidelines for Transmissible Spongiform Encephalopathies. ANSI/AAMI Standards ST79:2017 Annex C—Processing CJD contaminated patient care equipment and environmental surfaces.
7. NIH, Creutzfeldt-Jakob-Disease-Fact-Sheet. https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Creutzfeldt-Jakob-Disease-Fact-Sheet.

▲ (USP 1-Dec-2019)

Auxiliary Information - Please check for your question in the FAQs before contacting USP.

Topic/Question	Contact	Expert Committee
<1229.16> PRION STERILIZATION	Huiping Tu Director, Biologics	GCM2022 General Chapters - Microbiology 2022

Most Recently Appeared In:
Pharmacopeial Forum: Volume No. PF 44(5)

Current DocID: GUID-E188A886-187E-45DE-B4AD-D34F3B86864E_2_en-US
DOI: https://doi.org/10.31003/USPNF_M12456_02_01
DOI ref: dre3f