



Disinfection Techniques for *Cryptosporidium*



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Abstract

Cryptosporidium, a protozoan parasite, is hearty in the environment and resistant to commonly used disinfectants. Additionally, many species of *Cryptosporidium* are zoonotic. To prevent disease transmission and contamination of the water table, the proper disinfectant must be selected. This review will highlight the proper techniques needed to prevent the spread of disease in a cryptosporidiosis outbreak.

Keywords: *Cryptosporidium*; cryptosporidiosis; disinfection; hydrogen peroxide; ammonia; steam cleaning; zoonosis; Mammals; Birds; Reptiles; Amphibians; Fish; Chlorine; Zoonotic; Hydrogen

Introduction

Cryptosporidiosis is a disease affecting both humans and animals caused by the protozoan parasite, *Cryptosporidium*. Thirty species of *Cryptosporidium* have been described from a wide range of vertebrate hosts including humans, wild and domestic mammals, birds, reptiles, amphibians, and fish causing asymptomatic or mild-to-severe disease in the host [1,2]. Most species of *Cryptosporidium* will cause diarrhea by infecting the intestinal tract of the host, but some *Cryptosporidium* species will infect other organs, such the stomach of snakes and frogs [3,4], the lungs and kidneys of birds [5-7] and the spleen, liver and gills of fish [8]. *Cryptosporidium* is hearty in the environment and resistant to commonly used disinfectants and most of the species which infect mammals are zoonotic [9].

Some of the commonly used disinfectants ineffective in deactivating *Cryptosporidium* oocysts include bleach (sodium hypochlorite), chlorine, quaternary ammonium compounds, phenols, and glutaldehyde [10-12]. The inherent resistance of *Cryptosporidium* oocysts to many disinfectants restricts the choice of disinfectant for cleaning animal enclosures when there is a concern that *Cryptosporidium* may be present [3,12-15]. Ammonia is effective in eliminating oocyst infectivity after 18 hours contact at room temperature [16,17]. This can be easily achieved by diluting liquid ammonia 1:2 or 1:5 with water [16]. Hydrogen peroxide at a concentration of 6%, which is relatively non-toxic, is lethal to oocysts after exposure at room temperature for 20 minutes [12,18-20].

Elevated temperatures have also been shown to inactivate *Cryptosporidium* oocysts. The amount of time necessary to

inactivate the parasitic cysts depends on the temperature. The oocyst infectivity is neutralized by exposure to moist heat over 70 °C (158 °F) for twenty minutes [12,15,16,21]. If the temperature is elevated to 80 °C (176 °F) oocysts will be inactivated after two minutes [22]. If the temperature is decreased to 65 °C (149 °F), the time necessary to inactivate the oocysts is increased to thirty minutes [23].

Zoonotic *Cryptosporidium* oocysts can eventually wind up in the water supply used for human consumption. When drinking water is contaminated with *Cryptosporidium*, the disinfection procedures for many municipal water treatment plants are challenged. Since chlorine and sodium hypochlorite are not effective control measures in preventing the spread of *Cryptosporidium*, other disinfecting protocols are needed to prevent zoonotic transmission of these oocysts. Some effective water disinfecting techniques include the use of ultraviolet light, ozone, titanium dioxide photo-analysis, and ultrasound [11,24-26]. Interestingly, natural sunlight has been shown to inactivate *Cryptosporidium* oocysts [27]. A recent study demonstrated that eight hours sunlight exposure of potable water in plastic bottles is effective in completely inactivating any contaminating *Cryptosporidium* oocysts, thus offering an applicable, economical and convenient method for the control of cryptosporidiosis especially in developing countries [24].

Discussion

When dealing with a cryptosporidiosis outbreak in an animal population, the veterinarian must take precautions to prevent the spread of disease within the animal population as well as

preventing zoonotic infection. Isolating the infected animals from the remaining population is a must. The provision of separate cleaning equipment for each enclosure decreases the risk of cross-transmission of cryptosporidiosis and of other pathogens [19]. All waste products from mammalian cryptosporidiosis cases should be treated as biohazardous waste to prevent the spread into the ground water.

All items associated with the infected animal need to be thoroughly cleaned and disinfected. Any item that is disposable should be discarded. Thorough cleaning with hot, soapy water is necessary prior to the use of a disinfectant. The use of a steam cleaner should be considered, especially if the cleaned items can be brought to 80°C (176 °F) for two minutes. Proper personal protection equipment (PPE) needs to be employed to prevent accidental zoonosis. PPE includes disposable latex or nitrile gloves, eye protection, and a respirator. Using disposable Tyvek® coveralls, or similar product, should also be employed as *Cryptosporidium* oocysts can attach to fabrics during machine washing [28].

Ammonia is commonly used as a disinfectant during a cryptosporidiosis outbreak, but there are several drawbacks to this method. Ammonia needs to have an 18-hour contact time to inactivate *Cryptosporidium* oocysts. This is often not practical in many situations. Additionally, if the animals are in a confined space, the ammonia gas fumes from this process is irritating to respiratory and ocular membranes and be toxic to animals and humans.

Hydrogen peroxide is a less toxic alternative to ammonia. The concentration of hydrogen peroxide, however, needs to be at least 6% to effectively inactivate *Cryptosporidium* oocysts. This concentration is caustic and corrosive, so proper care needs to be taken when handling this product. The major advantages of using 6% hydrogen peroxide over ammonia are no irritating, toxic fumes and a dramatically shorter contact time of 20 minutes compared to 18 hours for ammonia.

Non-disposable medical equipment used on any *Cryptosporidium* infected animal needs to be sterilized before use on another animal. Autoclave, ethylene oxide gas, and hydrogen peroxide gas plasma (STERRAD®) are the only methods of sterilization that are effective in inactivating *Cryptosporidium* spores [12]. Cold sterilization techniques using 2% glutaldehyde have been shown to be ineffective in inactivating *Cryptosporidium* oocysts [12].

Conclusion

Adoption of a few simple control procedures can limit disease spread during an outbreak of cryptosporidiosis. Scrubbing of contaminated surfaces and the prompt removal and appropriate disposal of contaminated wastes will remove reservoirs of parasites thereby reducing the risk of spread of infection. Proper selection of appropriate disinfectants must be made to ensure prevention of disease spread.

Conflict of Interest

This manuscript was prepared and reviewed with the participation of all the authors, who declare that they have no conflict of interest that compromise the validity of the results.

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