



A NEW PEROXIDE-BASED FAST ACTING SURFACE SPORICIDE

N.Omidbakhsh, Ph.D. Candidate
Virox Technologies, Inc., Canada



ABSTRACT

Clostridium difficile (*C.diff*) is the main cause of hospital-acquired diarrhea. Environmental contamination is one of the major factors in hospital-acquired infections, and consequently proper cleaning and disinfection of environmental surfaces such as toilets and commodes can be of major help in reducing the risk of infection. However, since *C.diff* forms spores, it is resistant to most commercially available surface disinfectants. Applying ineffective cleaners/disinfectants can cause cross contamination. Currently, the preferred biocide to combat *C.diff* on surfaces is chlorine. Although chlorine is effective in inactivating *C.diff* spores, it is very corrosive and an skin, eye and respiratory irritant. It also has an unpleasant and pungent smell at the effective sporicidal concentration. This results in over-diluting chlorine solutions which makes them ineffective against the *C. diff* spore. The objective of this study is to address this issue by introducing a practical solution for *C.diff* infection control using a recently formulated mild surface sterilant based on Accelerated Hydrogen Peroxide.

Methods: A new peroxide-based fast acting surface sporicide was tested for its microbial activity against spores, bacteria and viruses using carrier test methods.

Results: The product inactivates the spores with a contact time of 10 min, and bacteria and viruses at 1 min. The formulation comes in both gel and liquid form. The gel can remain on inclined surfaces such as toilet bowls for a longer contact time, resulting in complete sporicidal activity.

Conclusions: This novel product with recommended protocols significantly reduce the risk of infections, specifically, infections caused by *C.diff* spores.

INTRODUCTION

Clostridium difficile (*C.diff*) is a spore forming gram positive bacteria, which is the main cause of hospital-acquired diarrhea. Because of its sporal form, *C.diff* can easily survive in the environment for a long period of time. *C.diff* is usually transmitted from hands of patients, or health care workers, or from the environment. When the *C.diff* spore is ingested, it can survive in the stomach, convert to its vegetative form in the colon, and

produce toxins that cause clinical symptoms including severe diarrhea, abdominal pain, and dehydration. With the increased number of *C.diff* infection over the last decade, it has become more difficult to minimize the exposure of patients to sources of *C.diff*. The main source for *C.diff* in health care facilities are the toilets where the large number of *C.diff* spores can be spread from patients. *C.diff* is very resistant to many germicides due to its sporal form. Most cleaning products are inefficient at killing the spore form of *C.diff* and only spread it around, and result in cross contamination. Moreover, it has been demonstrated that some cleaning agents and disinfectants such as quats promote sporulation of *C.diff* which further increases the infection risk. Currently, the preferred biocide to disinfect surfaces contaminated with *C.diff* is chlorine. Other disinfectants such as alcohols, quats, and phenolics are not sporicidal even at high concentrations and therefore, are not effective.

Chlorine is an effective sporicide, but has many disadvantages. It easily becomes inactivated in presence of organic matter, as such it is recommended to pre-clean the surfaces before disinfecting with chlorine, which may lead to cross contamination. Chlorine has a pungent smell, especially at concentrations required to be effective as a sporicide. Consequently the users tend to over-dilute chlorine to avoid the pungent smell, which results in insufficient inactivation of *C.diff*. Moreover, chlorine is corrosive toxic, and a known respiratory irritant.

In this study, an alternative for chlorine has been demonstrated. This new product is based on Accelerated Hydrogen Peroxide, and comes in two different formats, liquid and gel. The gel form is useful especially for inclined surfaces so the product keeps the surface wet for the required disinfection contact time.

MATERIALS AND METHODS

Formulation tested: The product tested in this study, Accel C.diff gel, is a newly developed, AHP-based surface sporicide.

Accel C.diff gel is a blend of 4.5% hydrogen peroxide, anionic surfactants, non-ionic surfactants and stabilizers. It is a clear, colorless and odorless liquid with a pH of 2.5-3.0. It is free from alkyl phenol ethoxylates (APEs). The formulation is currently in the registration process for sale in Canada.

Accel C.diff was tested for its antimicrobial activity, and stability using well-recognized protocols.

Stability Tests were conducted to comply with paragraph C.01.062 in the Food and Drugs Act, wherein the concentration of medicinal active in a drug product cannot lie outside of a band defined by 90% to 110% of the nominal concentration.

Antimicrobial Tests: Three lots of the test solution were tested using the quantitative carrier test method (ASTM 2111-00).

RESULTS

Stability Tests

The solutions showed a 12% loss for hydrogen peroxide in one year at room temperature. Based on these results and reasoning, the product is stable for a period of 18 months if manufactured at about 110% of its active nominal concentration.

Microbicidal tests:

Test Organism	Contact time	CFU per control carrier	CFU per test carrier	Log ₁₀ reduction
<i>Bacillus subtilis</i> (ATCC 19659)	10 min	1.05 x 10 ⁷	0	7.02
<i>Clostridium sporogenes</i> (ATCC 7955)	10 min	1.11 x 10 ⁷	0	7.05
<i>Clostridium difficile</i> (clinical isolate)	10 min	8.03 x 10 ⁷	0	7.90
<i>S. aureus</i> (ATCC 6538)	1 min	3.90 x 10 ⁶	0	5.55
<i>P. aeruginosa</i> (ATCC 15442)	1 min	2.64 x 10 ⁶	0	6.42
<i>S. choleraesuis</i> (ATCC 10708)	1 min	8.17 x 10 ⁶	0	6.91
<i>Trichophyton mentagrophytes</i> , (ATCC 95 33)	1 min	1.32 x 10 ⁶	0	6.12
Poliovirus type 1, Sabin (ATCC VR-192)	1 min	2.76 x 10 ⁶	0	5.69

The above results show that Accel C.diff is a 10 min sporicide and 1 min bactericide and virucide.

DISCUSSIONS AND CONCLUDING REMARKS

Clostridium difficile spore infection control is one of the major challenges in health care facilities. Cleaning products are not useful in decontaminating surfaces as they cause cross-contamination. Moreover some cleaning and disinfecting agents such as quats promote sporulation of the vegetative form of *C.diff* and therefore increase the infection risk. Chlorine is currently the only product of choice to combat *C.diff*. However chlorine has many disadvantages such as pungent smell, high corrosivity, high toxicity and is easily inactivated in presence of organic matter.

Accel C.diff gel and liquid are new surface sporicides that address the disadvantages of chlorine solutions. It is a one-step fast acting, low toxicity sporicide without any pungent odor. The formula cleans and disinfects at the same time, therefore eliminates the need for cleaning products and consequently does not cause cross contamination. Accel

C. diff Gel can also work on inclined surfaces, as it remains on these surfaces for the required contact time due to its gel form.

REFERENCES

1. Abdul B. Zafar, Larry A. Gaydos, William B. Furfong, Michelle H. Nguyen, Patricia A. Mennonna, Effectiveness of infection control program in controlling nosocomial *Clostridium difficile*, American Journal of Infection Control, Vol.26, No.6, 588-593, Dec.1998
2. P. Verity, M.H. Wilcox, W. Fawley and P. Parnell, Prospective evaluation of environmental contamination by *Clostridium difficile* in isolation side rooms, Journal of Hospital Infection, 49:204-209, 2001
3. Mark H. Wilcox, Warren N. Fawley, Hospital disinfectants and spore formation by *Clostridium difficile*, The Lancet. Vol 356, Oct.14.2000