

Evaluation of Quat Absorption and Efficacy of Cleaning Cloths

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BACKGROUND/OBJECTIVES:

Quaternary ammonium disinfectants are frequently used on hospital surfaces. Recently, concern has arisen around the discovery that the active ingredient (quat) has a tendency to become attracted to and absorbed into fabrics. Furthermore, quaternary ammonium chlorides (quats) are cationic, or positively charged, surfactants, and they are attracted to fabric surfaces which are anionic, or negatively charged. This results in a portion of the quats becoming unavailable to adequately kill the microorganisms that may be present.¹

One study suggests that soaking cloths in disinfectant instead of using a pour bottle of disinfectant may provide a reduced likelihood of isolating either MRSA or VRE from the environment.² This correlates well with our previous studies documenting the effects of quat concentration with respect to soak time, volume of disinfectant and textile type.³

Both cotton terry cloth and microfiber cloths are used by housekeeping in healthcare facilities to apply disinfectant. Microfiber textile tools have been noted to maximize the efficiency of housekeepers as well as provide better cleaning.^{4,5} Superior cleaning and disinfection has previously been observed with the use of microfiber textile tools.^{6,7} This study observes effects of quat absorption and antimicrobial efficacy of each type of fabric.

METHODS:

Summary

Large petri dishes inoculated with MRSA were used to simulate 6 heavily-contaminated sites in a patient area. Disinfection efficacy of microfiber-cloth and cotton-terry-cloth swatches that had been soaked in two commercially-available quat disinfectant products was tested by using saturated cloths to wipe six consecutive inoculated plates. See test plan below.

Quat Use-Solution	Cloth Type	Usage
Product A	Microfiber	For each product and cloth type, use one saturated cloth piece to wipe six inoculated petri dishes
Product A	Cotton Terry	
Product B	Microfiber	
Product B	Cotton Terry	

Test Procedure

MRSA (Methicillin-resistant *Staphylococcus aureus* ATCC 33592) was grown in AOAC Nutrient Broth to 2.2 x 10⁸ CFU/mL. From that 24-hour culture, 0.25 mL was pipetted into each of 24 large petri dishes (150 mm x 15 mm) and spread with a plastic sterile hockey stick into a circle approximately 10 cm in diameter. The inoculated plates were dried in a 35oC-incubator for 30 minutes.

By calculation, approximately 5.5 x 10⁷ CFU was applied to each plate (2.2 x 10⁸ CFU/mL x 0.25 mL applied).

Two quat products (Product A and Product B) were diluted to label use- concentrations. Microfiber- and cotton-terry-cloth fabric pieces (each approximately 9 cm x 9 cm) were soaked in the prepared use-solutions of Product A and Product B for at least 15 minutes.

The soaked cloth pieces were handled with sterile gloves. Before being used to wipe inoculated plates, enough of the disinfectant use-solution was squeezed from a soaked cloth piece to leave it feeling "comfortably wet". The saturated weight of each cloth piece was documented and the average weight of the liquid, for each product within each cloth type, did not vary by more than 0.1 g. Then the cloth was used to wipe 6 inoculated plates, in sequence at 10-second intervals, wiping each plate for about 10 seconds. Ten minutes after beginning to wipe the plates, again at 10-second intervals in the same sequence, approximately 50 mL of D/E Neutralizing Agar was poured into each plate and the plate was swirled.

Ten minutes after wiping the last inoculated plate, the disinfectant-soaked wiping cloth was put into a sterile stomacher bag containing 99 mL D/E Neutralizing Broth and the bag was stomached for 30 seconds. Considering the neutralizer in the stomacher bag as the 10-2 dilution of the number of MRSA on the wiping cloth, 10-2 and 10-4 dilutions were pour-plated to D/E Neutralizing Agar.

Neutralization Controls

Previous work had established that the ~50 mL of D/E Neutralizing Agar poured into the wiped plates was sufficient to neutralize Product A (and was assumed to be sufficient to neutralize Product B, which had a lower quat concentration—see Chart 1 in Results).

Adequacy of the 99-mL D/E Broth used to neutralize quat disinfectant remaining on cloths after wiping 6 plates had also been verified.

Quat concentration in the initial use-solutions of Product A and Product B (diluted per label) was titrated with a quat test kit. After the microfiber- and terry-cloth swatches were soaked in the Product A and Product B use-solutions the quat concentration in each of the four post-soaking solutions was checked again.

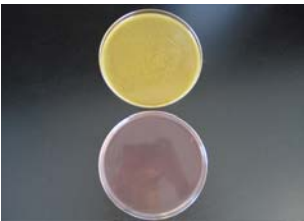
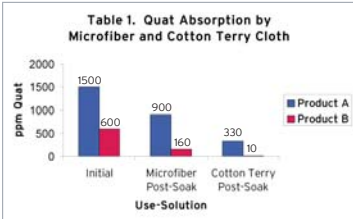


Figure #1: D/E Neutralizing Agar (Becton Dickinson, Sparks, MD) was used for plating surviving organisms. The sterile agar is purple in color; a yellow color indicates the presence of microbial growth.

RESULTS:



MRSA Survivors on Disinfectant-Soaked Cloths after Sequentially Wiping 6 Inoculated Plates (10-minute Exposure)

Product / Cloth Type	CFU per Cloth*
Product A / Microfiber	<100
ProGuard / Cotton Terry Cloth	<100
Product B / Microfiber	2.9 x 10 ⁴
Product B / Cotton Terry Cloth	3.3 x 10 ³

*99 mL of D/E Broth neutralizer in the stomacher bag is considered 10-2 dilution of the number of organisms on the cloth.

MRSA Survivors (CFU / Plate) on 6 Inoculated Plates after Sequential Disinfection
(Calculated Initial Inoculation 5.5 x 10⁷ CFU per Plate; Exposure Time: 10 Minutes)

Inoculated Plate	CFU per Wiped Plate			
	Product A Microfiber Cloth	Product A Cotton Terry Cloth	Product B Microfiber Cloth	Product B Cotton Terry Cloth
1	<1	<1	<1	3
2	<1	<1	1	1
3	<1	<1	1	3
4	<1	<1	2	15
5	<1	<1	3	36
6	<1	<1	86	41

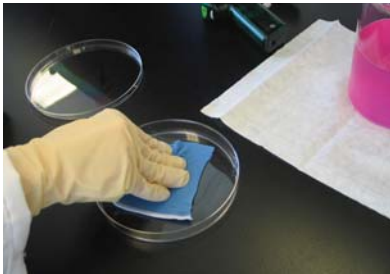


Figure #2: Microfiber cloth swatch saturated with product A applied to a contaminated petri dish.



Figure #4: Cotton cloth swatch saturated with product B applied to a contaminated petri dish.

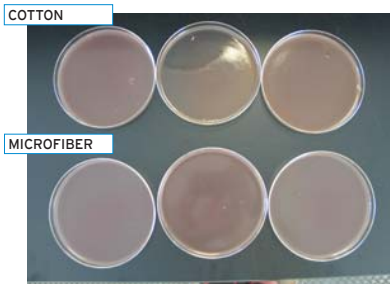


Figure #3: Results of the final three plates in the six plate series of contaminated plates: cotton cloth, microfiber cloth saturated with product A.

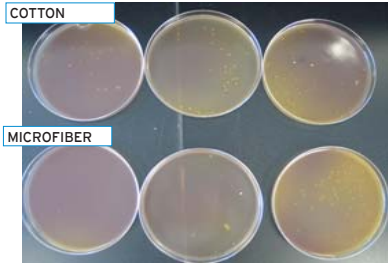


Figure #5: Results of the final three plates in the six plate series of contaminated plates: cotton cloth, microfiber cloth saturated with product B.

CONCLUSIONS:

Quat absorption occurs in cotton terry cloth as well as in microfiber cloth. Microfiber appears to be superior to cotton terry cloth in accounting for quat absorption, cleaning and disinfection efficacy, as well as in preventing organism transfer to clean surfaces. When using a quaternary disinfectant, quat absorption should be considered with any application which requires the use of a textile tool (cloth, mop, etc.).

Disinfectants which are labeled to deliver a high ppm active quat in solution to account for the quat absorption with textiles appear to be the biggest factor in delivering the proper disinfectant level to a surface. The method of allowing fabric to soak and absorb a high dilution level of quaternary disinfectant allows the solution to plateau at the disinfection level. The proper disinfectant level will provide disinfection efficacy against a high level (5.5 x 10⁷ CFU/ 150 mm petri dish) MRSA on the surface as well as prevent subsequent cross-contamination of surfaces.

REFERENCES

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