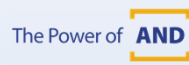


Testing the Bacterial Cleansing Activity of the Norwex™ Microfiber Cloth

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Introduction:

Bacillus subtilis and *Escherichia coli* are species of bacteria associated with food borne ailments. Strains of *Bacillus subtilis* are associated with food poisoning while a variety of strains of *E. coli* are associated with food-borne gastrointestinal diseases. Because of organisms such as these, maintaining proper kitchen hygiene is essential. The Norwex™ company has developed microfiber cloths that have silver nanoparticles woven in between the fibers. The company claims that the microfiber is capable of removing 99% of bacteria from surfaces and that the silver is an anti-microbial agent that will inhibit the growth of microbes in the cloth. In this study, the ability of the Norwex™ microfiber cloth to remove microbes from surfaces and inhibit microbial growth within the cloth is compared to a similar microfiber cloth that lacks the silver nanoparticles. Preliminary results using the bacterial species *Bacillus subtilis* and *Escherichia coli* do not show a significant difference between the two types of microfiber cloths in removing bacteria from surfaces nor in inhibiting the growth of microbes within the cloth. Future experiments will utilize additional species of bacteria as well as the yeast *Saccharomyces cerevisiae* to determine if the results obtained for these species are consistent with the results we have observed for *B.subtilis* and *E.coli*.

Methods:

Removal of Bacteria:

8ml of either *B. subtilis* or *E. coli* (1×10^6 cell/ml) were placed into sterile petri dishes. The bacterial solution was soaked up using either the Norwex™ cloth or the regular microfiber cloth. After the cloths were removed, 10ml of sterile water was added to the petri dish to resuspend residual bacteria. The resuspended bacteria were diluted and then inoculated onto Mueller Hinton (MH) agar plates. The colonies were counted following an overnight incubation at 37C and the number of unbound bacteria was determined.

Growth of Bacteria in Cloth:

The towels that were used in the above procedure were rinsed with hot tap water and placed on a sterile drying rack overnight. The towels were then soaked with 10ml of sterile water and the water was then wrung out of the cloths into a sterile petri dish. 1ml of this solution was inoculated onto MH agar plates, incubated overnight at 37C, and the colonies counted.

Results:

Figure 1. Percentage of *E.coli* Bound by Cloth



Percentage of the initial 8×10^6 bacteria bound by microfiber and Norwex™ cloths

Figure 2: Percentage of *B. subtilis* Bound by Cloth

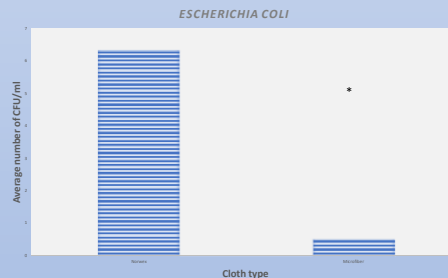


Percentage of the initial 8×10^6 bacteria bound by microfiber and Norwex™ cloths

Table 1: Statistical Analysis of Cloth Binding Data

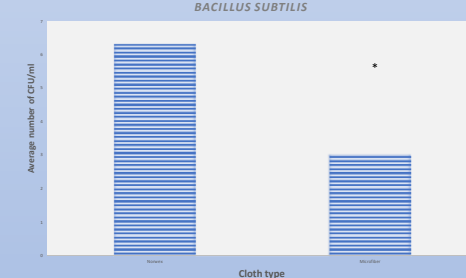
Cloth Type	Bacteria	% Bound (Mean)	95% CI
Microfiber	<i>E.coli</i>	99.1	+/- 0.01
Norwex™	<i>E.coli</i>	99.2	+/- 0.15
Microfiber	<i>B.subtilis</i>	97.8	+/- 5.96
Norwex™	<i>B.subtilis</i>	96.7	+/- 4.82

Figure 3. Bacteria Remaining in Cloth after Overnight Incubation



Bars represent average number of colony forming units per ml (CFU/ml). Asterisk (*) represents data from a non-valid plate with >500 colonies.

Figure 4. Bacteria Remaining in Cloth After Overnight Incubation



Bars represent average number of colony forming units per ml (CFU/ml). Asterisk (*) represents data from a non-valid plate with >500 colonies.

Conclusions:

Both the microfiber and Norwex™ cloths were able to bind approximately 99% of both the *E.coli* and the *B.subtilis* from the surface of a sterile petri dish. There was no statistical difference between the binding ability of the microfiber cloth and the Norwex™ cloth. In addition, there is no evidence to support any inhibitory effect due to the silver nanobeads in the Norwex™ cloth as there was no difference in the number of bacteria remaining in the cloths after an overnight incubation. Future experiments will utilize additional microbial species and assess the growth of microbes in the cloth for an extended period of incubation.

References:

Bartz, Sabrina, and Eduardo Cesar Tondo "Evaluation of two recommended disinfection methods for cleaning cloths used in food services of southern Brazil" *Brazilian Journal of Microbiology* 44, 3, 765-770 (2013)
Vimbel, Gina V., Sang M Ngo, Carolyn Fraze, Lei Yang, and David A Stout "Antibacterial properties and toxicity from metallic nanoparticles" *International Journal of Nanomedicine* 12, 3941-3965 (2017).

Acknowledgments:

UWEC Office of Research and Sponsored Programs Provided Funding to Support This Project
Learning and Technology Services Provided Poster Printing Services