Spring 2015

Assessment of Bacterial Survival on Disposable Lab Coats Used in Microbiology Teaching Labs

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Introduction

In the past few years, there have been multiple instances of individuals becoming ill after participating in microbiology teaching labs at universities. This has led to altered safety recommendations, including the use of disposable lab coats in microbiology labs. The purpose of this project is to determine whether the levels of bacterial transfer and survival of paper lab coats is high enough to justify requiring Microbiology Departments to issue lab coats for every student in each lab. *Escherichia coli, Staphylococcus aureus*, and *Staphylococcus epidermidis* have been used as model organisms since they are common teaching laboratory bacteria. Various methods of recovery including replica plating, swabbing, and vortexing portions of lab coats in order to dislodge bacteria have been utilized.

Tyvek Lab Coats

The lab coats being tested were made from flash-spun high-density polyethylene fibers. This material did not appear to have any inherent antimicrobial or microbial enhancing properties when small pieces of the coat were plated with a lawn of bacteria, as seen in **Figure 1**.

Outbreak in Microbiology Labs

From November 1, 2013, to May 4, 2014, there were 41 individuals infected with a strain of *Salmonella typhimurium* found to have come from various clinical and college teaching laboratories. As a result of this outbreak, many microbiology teaching labs changed their policies and safety practices in order to prevent more outbreaks. Clemson University was one such institution. Clemson started to use disposable lab coats that could be left in the teaching labs as the class progressed through the semester so as to decrease the risk of contaminants being brought home.

Current work

Methods and Materials

Dilution Series

Replica Block Method

Squares out autoclaved lab coats were inoculated with 50 µL of bacterial cultural and spread within a circle drawn, about the same diameter as the replica block as seen in the figure below. When testing immediate cell viability, the inoculated lab coat is placed on the block and is pressed against the Tryptic Soy Agar (TSA) plates for 5 seconds. To determine whether the bacteria bleeds through the lab coat, the block is rinsed with Bacdown, and when it dries, the process is repeated using the opposite side of the lab coat square and a separate TSA plate. The plate is then incubated at 37 ºC for 24 hours. These steps are the same when testing for 10 minute cell viability, except the lab coat when inoculated is left to sit for 10 minutes before being plated.

Q-tip Method

The incoluation of the lab coat square is the same for this method. However, instead of using the replica block, a sterile q-tip is dipped in Tryptic Soy Broth (TSB) and swabbing it on the lab coat to pull off microbes. The q-tip is then streaked on a TSA plate and incubated for 24 hours.

Vortex Method

When inoculating the lab coat for the vortex method, the lab coat square is cut into small circle before inoculation. The circle is then placed in a conical tube filled with 15 mL of TSB and vortexed for 30 seconds. 50 µL is then taken from the tube and plated on a TSA plate and incubated at 37 ºC for 24 hours.

Calculations

CFU counts are made the next day to determine cell viability

Preliminary Results

Culture	Immediate Cell Viability	10 minute Cell Viability
E. coli	23.05%	3.9%
S. epidermidis	27.01%	7.55%
S. aureus	3.15%	2%

Table 1. Average Recovery Rates of E. coli, S. epidermidis, and S. aureus

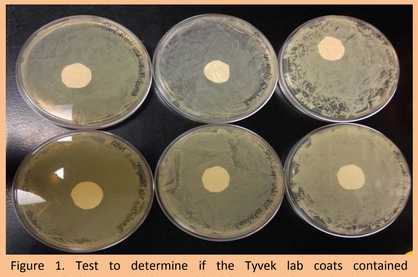

Figure 1. Test to determine if the Tyvek lab coats contained antimicrobial properties that would inhibit bacterial growth using pieces of lab coats both autoclaved and not. This figure suggests the Tyvek lab coats do not have antimicrobial properties

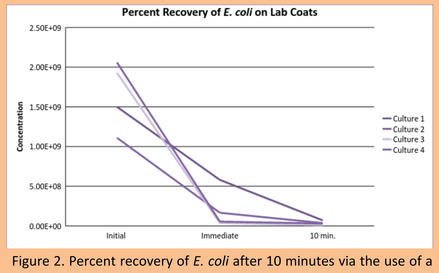

Figure 2. Percent recovery of *E. coli* after 10 minutes via the use of a replica block. A large decrease was seen in both immediate and 10 minute recovery

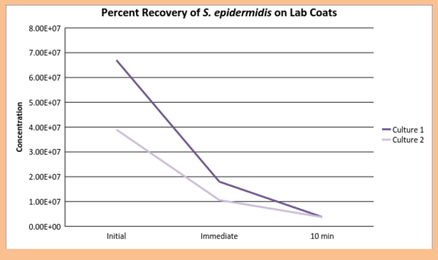

Figure 3. Percent recovery of *S. epidermidis* after 10 minutes via the use of a replica block.

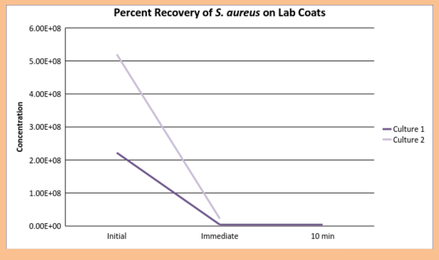

Figure 4. Percent recovery of *S. aureus* after 10 minutes via the use of a replica block.

Conclusions

Our results show that significant levels of *E. coli* survive on the lab coat for at least 10 minutes after inoculation. Preliminary results also indicate that a portion of the *E. coli* is transferred through the layers of the lab coat. Our research indicates that lab coats are a possible source of contamination, and it suggests that using disposable lab coats, which are not taken home with the students, may be a valid safety recommendation.

Problems and Future Directions

Contamination issues have been concerning, mainly fungal, possibly due to the air flow in the laboratory. The *S. aureus* has not has not had the expected levels of recovery, which could possibly be from desiccation, or the adhesive properties associated with virulence could be causing the microbes to stick to the lab coats too well. The Q-tip and vortexing methods did not appear to recover as many microorganisms as we had seen in previous tests using undiluted bacteria. Inconsistent methods of inoculation and replica plating may have caused skewed results, such as the amount of pressure applied to the replica block. Our future directions include placing inoculated lab coats in a Ziploc bag and determining the effect less oxygenation has on survivability and recovery of microbes. Students have been placing their lab coats in Ziploc bags at the end of their lab sessions so our lab would like to determine whether any contamination can survive under these conditions to possibly cause infection in later lab periods. Another future study for the project could be working with cloth lab coats rather than plastic to compare the recovery of bacteria with different material. Work with different microbes can provide us with more of an understanding of the difference of cell viability on plastic lab coats.

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Acknowledgements

John Ambercrombie for the donation of bacterial stocks.
Clemson University Department of Biological Sciences
Creative Inquiry Program