Use of a Nanotechnology Surface Coating (BioShield®75) Against Foodborne Pathogenic Bacteria

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Abstract

Biostatic agents that are intended for surface application can inhibit the growth of microorganisms, and their use is becoming increasingly popular throughout the food industry (1). BioShield®75 is a surfactant designed to inhibit microorganisms through the use of the Octadeylaminodimethyltrihydroxysilyl propyl ammonium chloride molecule. This compound is in the family of quaternary ammonium antimicrobials and was tested against two common foodborne bacteria, *Listeria monocytogenes* and *Salmonella*. Stainless steel coupons were used to simulate a typical food processing surface. BioShield®75 was applied to half the coupons, with *Salmonella* and *Listeria monocytogenes* applied to all. After storage at room temperature for two hours, the coupons were enumerated on tryptic soy agar (TSA); a nonselective media. This media was effective because only one bacteria strain was on each coupon at a time therefore selective media wasn't needed. After plate counting BioShield®75 was shown to be effective against *Listeria monocytogenes* producing an average reduction of viable cells by 3.5 log Colony Forming Units (CFU). *Salmonella* was only killed by 1 log CFU both with and without BioShield®75, proving the compound has very little effect on the bacterium. After completing the trials it appears that BioShield®75 may be useful to prevent *Listeria monocytogenes* contamination, but it may not be effective against other bacteria.

Introduction

Protecting food and avoiding recalls is a big priority for the food industry. Antimicrobials are used throughout the industry to provide the necessary protection. The idea of applying a solution to a surface, which can then create a matrix defending that surface from harmful bacteria is a relatively new concept. Nanotechnology is responsible for these developments, and BioShield®75 is a member of this new market (2). Two dangerous pathogens associated with food are *Salmonella* and *Listeria monocytogenes*. *Listeria* causes listeriosis, a serious disease that can lead to miscarriages and stillbirths in pregnant women (3). *Salmonella* can lead to salmonellosis including fever, cramps and diarrhea. *Salmonella* is the leading cause of hospitalizations and deaths from a foodborne bacteria (4). If the effectiveness of this nanotechnology can be proven it could potentially change plant sanitizing procedures.

Methods and Materials

Preparation of Coupons: One inch circular stainless steel coupons were used to simulate a food processing surface. For each trial 50 µL of BioShield®75 was applied directly to the surface of half the coupons., and 20 µL of culture was applied to each chip after 1 day of incubation at 23ºC (room temperature).

Culture Preparation: Before each trial 100 µL of pure culture was taken from a stock culture and put into a tryptic soy broth test tube and allowed to grow over night. This culture was then used the following day in the trail and would be diluted to the necessary concentration using peptone water.

Enumeration of Bacteria from Coupons: After incubation with the bacteria the coupons were place in a peptone water test tube with glass beads to extract the bacteria from the coupons' surface. The peptone water and coupon mixture was then diluted to the necessary dilution factor using phosphate buffer solution and then 0.1 mL of the dilution was plated onto TSA plates. After 24 hours for *Salmonella* and 48 hours for *Listeria monocytogenes* of incubation at 37ºC the plates were removed and counted.

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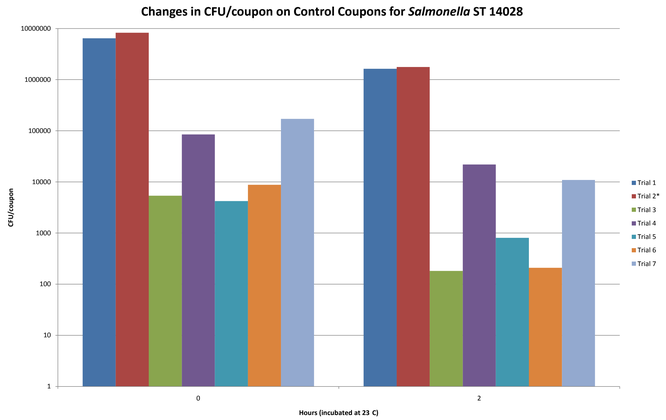
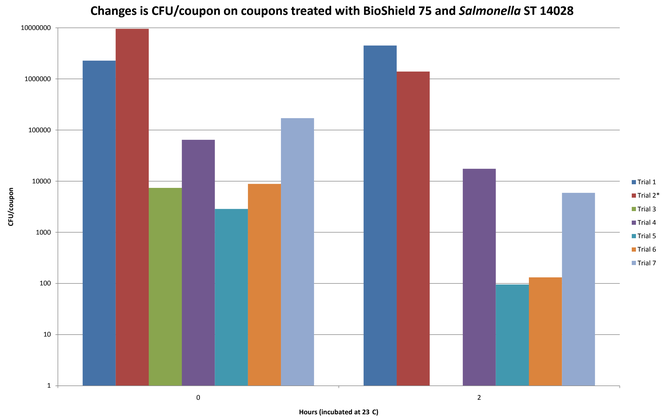
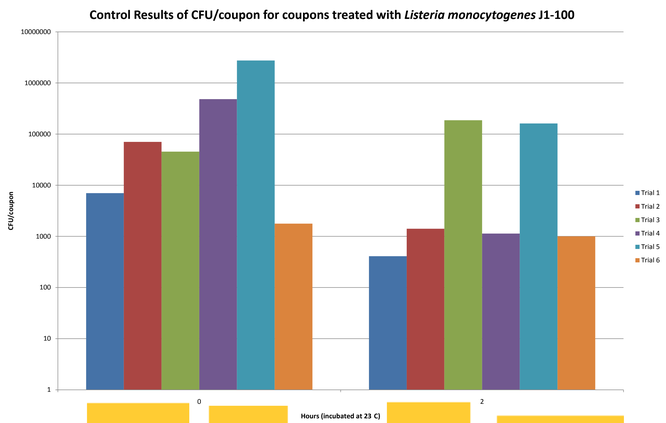
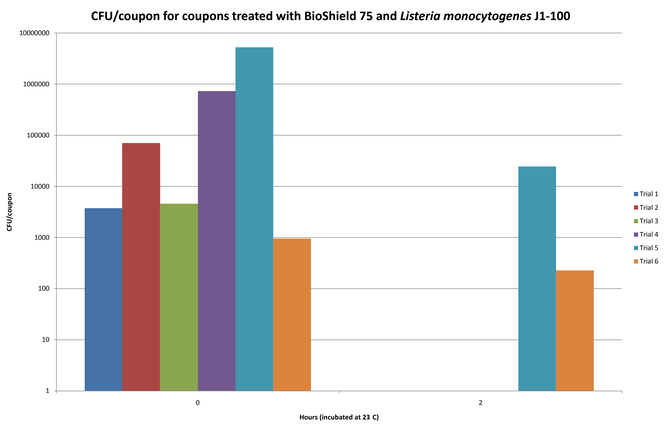




*=plates were incubated for 24 hours.





Discussion

- ❖ What causes the difference in effectiveness between *Listeria* and *Salmonella*?
- ❖ How does initial concentration of microbes affect BioShield®75's antimicrobial activity?
- ❖ BioShield®75 is designed for long term surface protection, the company claims it last, "30 days or longer on practically any surface." Considering that what type of cleaning can it withstand, and when is it removed from the surface?
- ❖ The website describes BioShield®75 as having "large molecular spikes [that] are long carbon chains that are large enough to pierce the cell walls of various microbes." How does the chain length affect the ability of BioShield®75?
- ❖ Can BioShield®75 work better on different surfaces? Is stainless steel more conducive to the formation of the, "highly durable protective coating," described by the company?

Conclusions

- ➢ BioShield®75 was more effective killing *Listeria monocytogenes* than *Salmonella*.
- ➢ Stainless steel provides a surface upon which the BioShield®75 can attach.
- ➢ A 1 log reduction on average will occur during a 2 hour incubation regardless of BioShield®75 being present.

References

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