Bactericidal Effectiveness of Magnesium Oxide in Composite Polylactic Acid Films

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Objective:

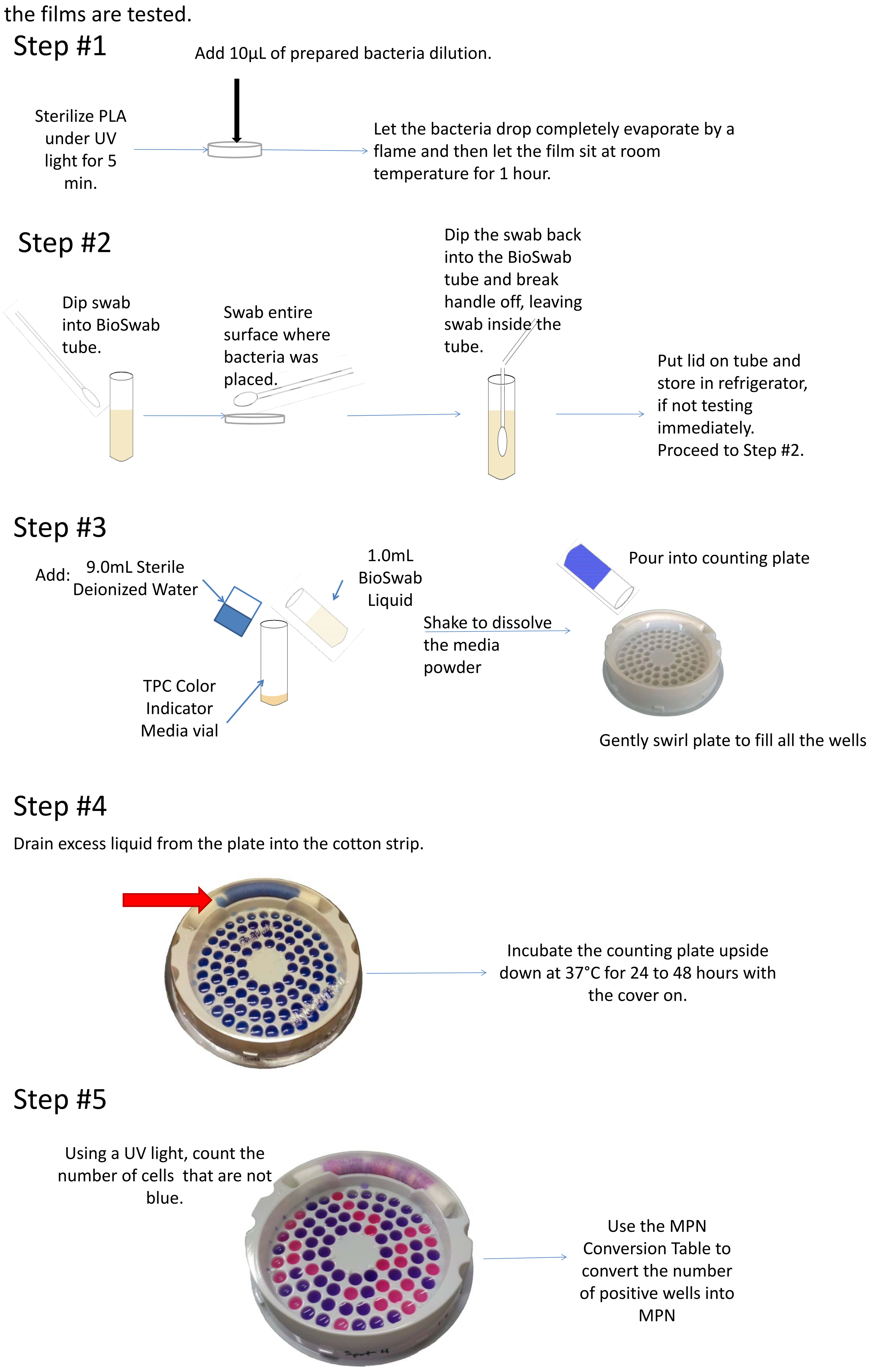
To determine the bactericidal effectiveness of crystalline and xerogel Magnesium oxide (MgO) in a Polylactic acid (PLA) film.

Composite PLA Films:

The composite films are made by the team out of polylactic acid resin pellets. These pellets are dissolved in a solvent, dichloromethane, and then magnesium oxide is mixed into that. In this project, two types of magnesium oxide will be investigated. The first is crystalline magnesium oxide, which is produced commercially. The other is xerogel magnesium oxide, which is made by the team in lab. After the magnesium oxide is mixed in thoroughly, as it does not dissolve in the mixture, the solution is then pipetted into a Petri dish and left to dry for 24 hours. The finished product is shown at the right. These films could possibly be used for food container to kill bacteria.

Experimental Procedure:

In order to test the bacteria killing properties of these films, the Total Plate Count System from BioMedix was used. This system is comprised of a swabbing system, color change media, and a plastic dish with wells, called a SimPlate. *Staphylocococcus aures* was used since previous team's research used this same bacteria. The schematic below explains exactly how the films are tested.



Results:

Figure 1: Average MPN of Films tested

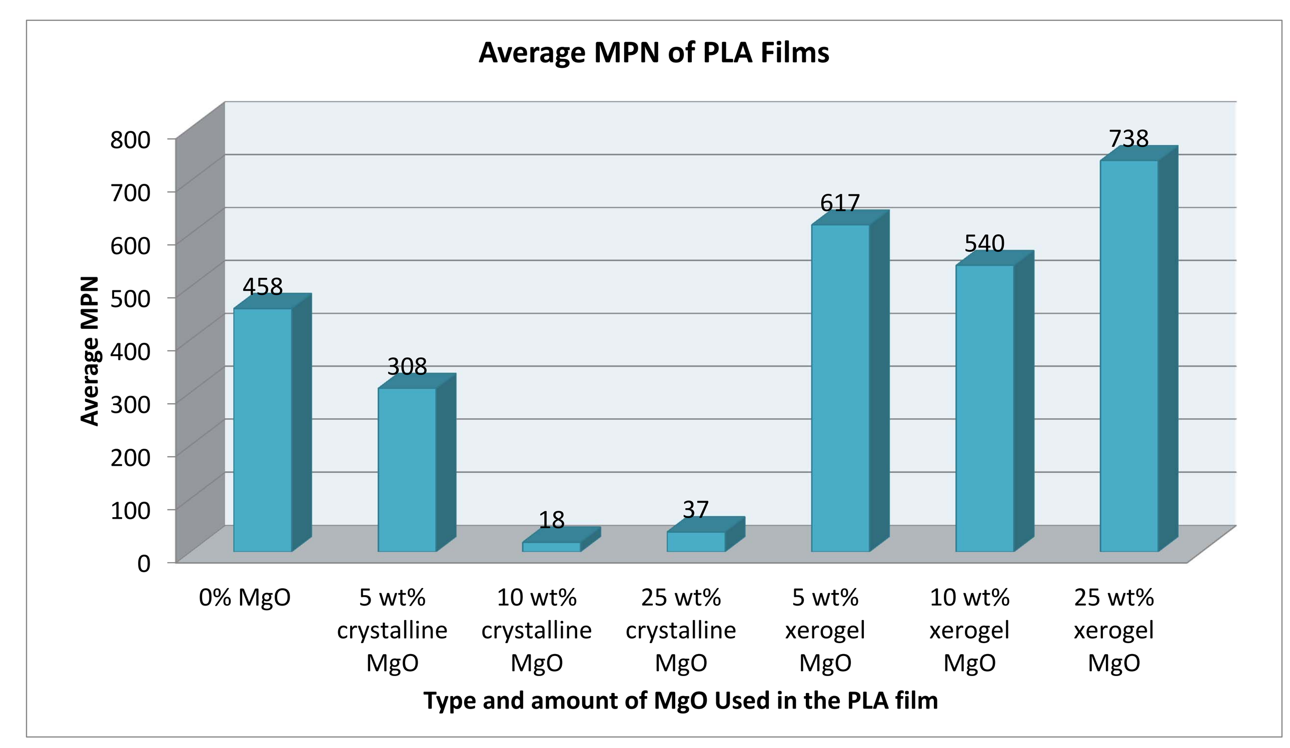
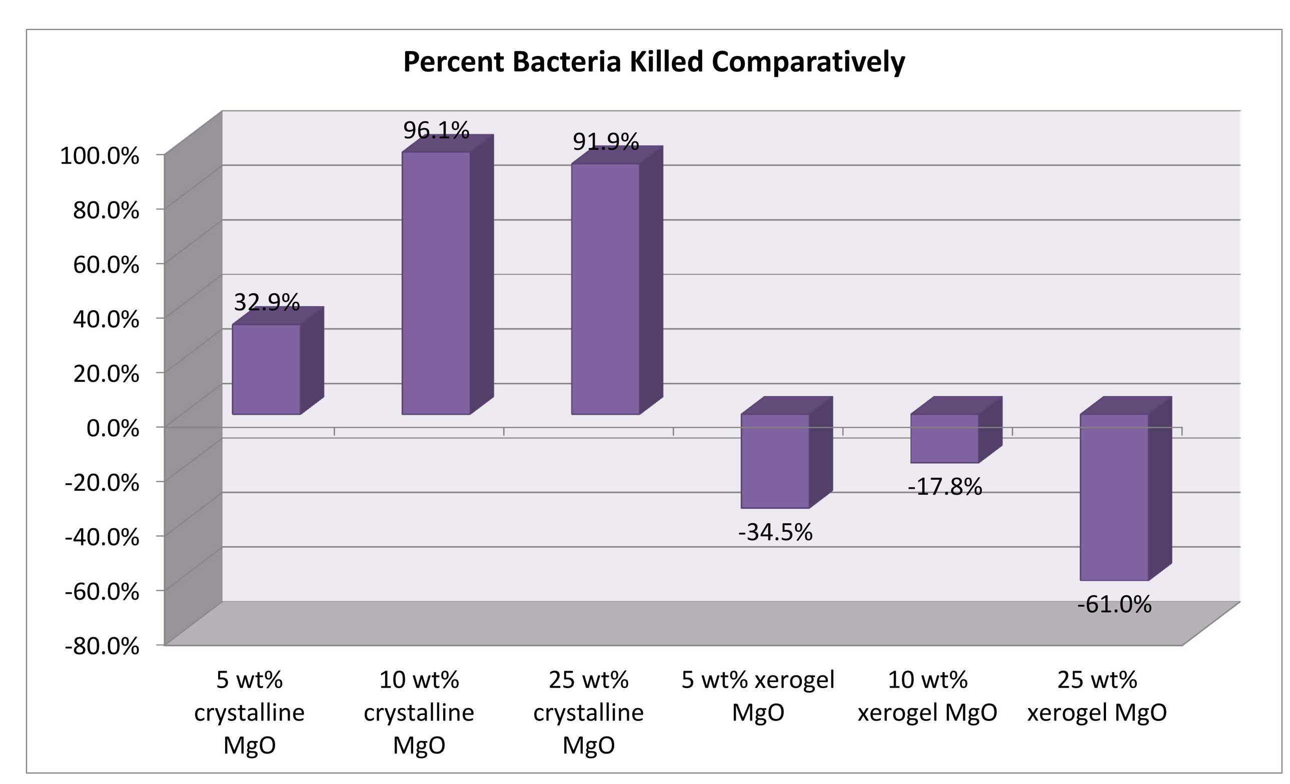
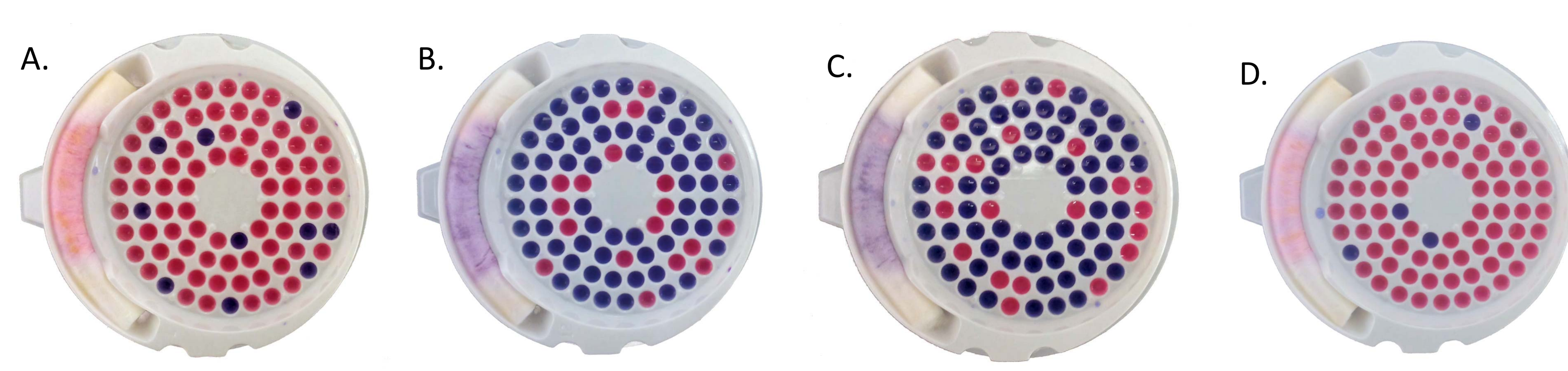


Figure 2: Percent Bacteria Killed in Comparison to the 0 wt% MgO film



The average values of MPN obtained from the SimPlate Total Plate Count system were plotted in Figure 1. From the graph, there is a significant drop in bacteria present on the films from a 0 wt% MgO film to a 10 wt% crystalline MgO film. There was slightly more bacteria present on the 25 wt% crystalline MgO film in comparison to the 10 wt% crystalline MgO film. All the xerogel samples had significantly more bacteria on them than any of the 0 wt% MgO films. Figure 2 uses the 0 wt% MgO film's MPN as a baseline and the percent drop in bacteria was calculated and plotted. The largest percentage of bacteria killed happened on the 10 wt% crystalline MgO film, which killed 96.1% of bacteria. The pictures below show the results of the SimPlate test and the color change that took place.



Results of the SimPlate test: 0% MgO film (A), 10 wt% crystalline MgO (B), 25 wt% crystalline MgO (C), and 5 wt% xerogel MgO (D).

Conclusions:

In conclusion, crystalline magnesium oxide was proven as an effective bactericide. The most effective weight percent film of all the crystalline films was the 10 wt% MgO PLA film. Xerogel magnesium oxide proved to not kill gram-negative bacteria.

Problems/Future Work:

One flaw with the SimPlate Total Plate Count system is the way bacteria left on the film are collected. Using the swabbing method, one has to have a consistent technique in order for the results to be relevant. A problem that this poses is that the films have varying degrees of roughness. Some of the films were very rough, therefore not all of the bacteria may have been retrieved. Other samples were extremely smooth, and the swabbing process was easy. This bacteria testing could be redone using a more efficient way to collect the bacteria present on the films.