



Efficacy of UV Sterilization In Relation to Surface Properties



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ABSTRACT

The efficacy of UV sterilization was investigated in relation to the properties of the surface. Lead, steel, acrylic, sponge, glass, and polystyrene were tested for the presence of bacteria after being disinfected using plate count agar method. The time until sterilization for each surface was compared.

Objective

To observe how the physical properties of a surface relate with the efficacy of UV sterilization

Background

UV disinfection is most commonly used in hospitals or in water disinfection plants. In both cases, surfaces disinfected mostly consist of steel. UV disinfection is primarily used to kill bacteria or other germs on surgical tools or in water. With the rising popularity of UV disinfection for home use, a relevant question to ask is how different surfaces affect the efficacy of disinfection.

Theory

The physical and chemical properties of a disinfected surface may affect the bacteria living on it. Metals Some materials will reflect light, absorb light, or provide a poor environment for bacteria to grow. For the purpose of testing all of these features, bacteria is tested on Steel and Lead (which reflect UVC light), acrylic and glass (which let UVC pass through) and sponge and polystyrene (which have geometry that may effect UVC exposure).

Hypothesis

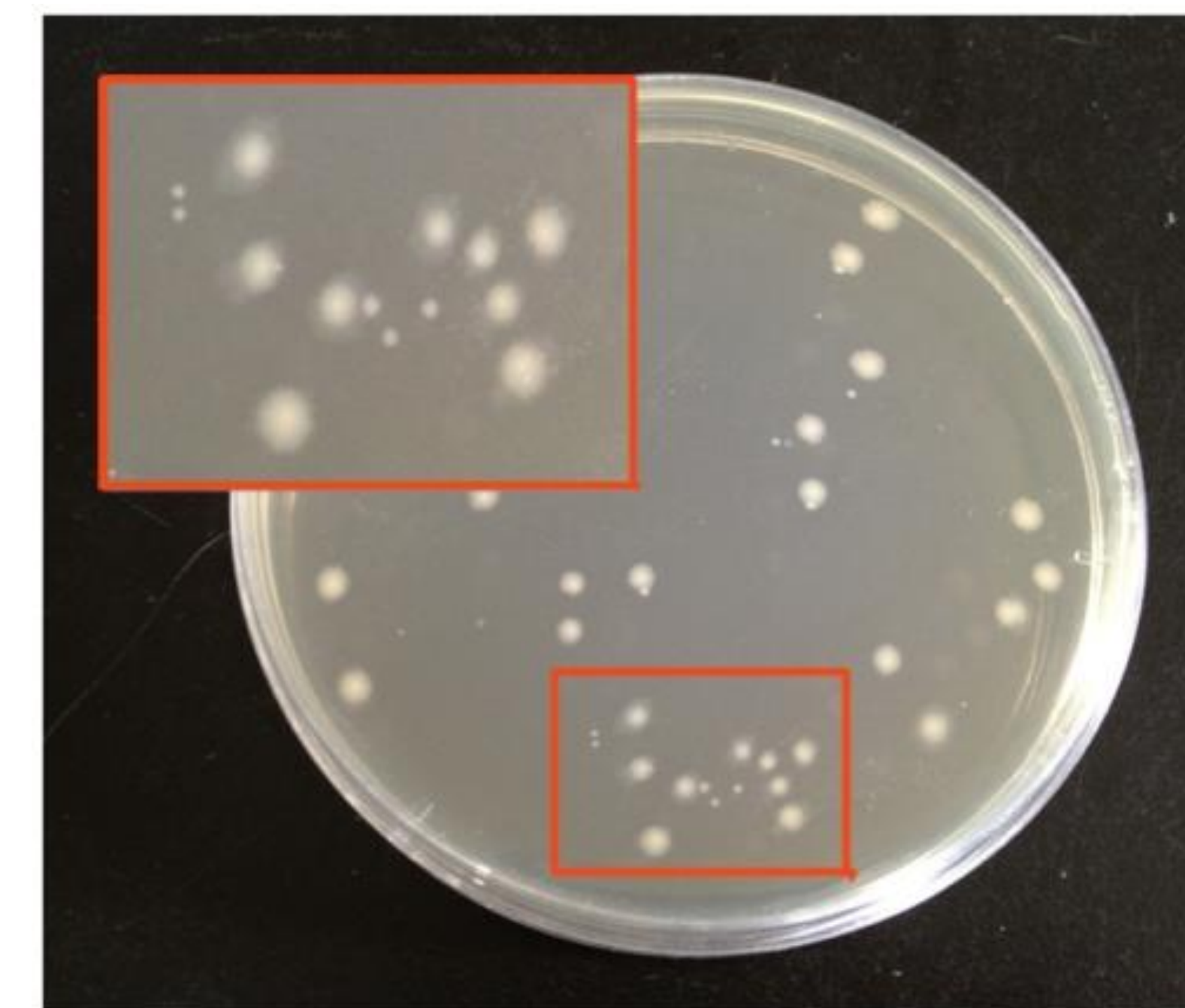
If the properties of a surface affect the efficacy of UV sterilization, and surfaces with varying properties are exposed to bacteria and disinfected, then the time it takes to disinfect the bacteria will vary by material.

Materials

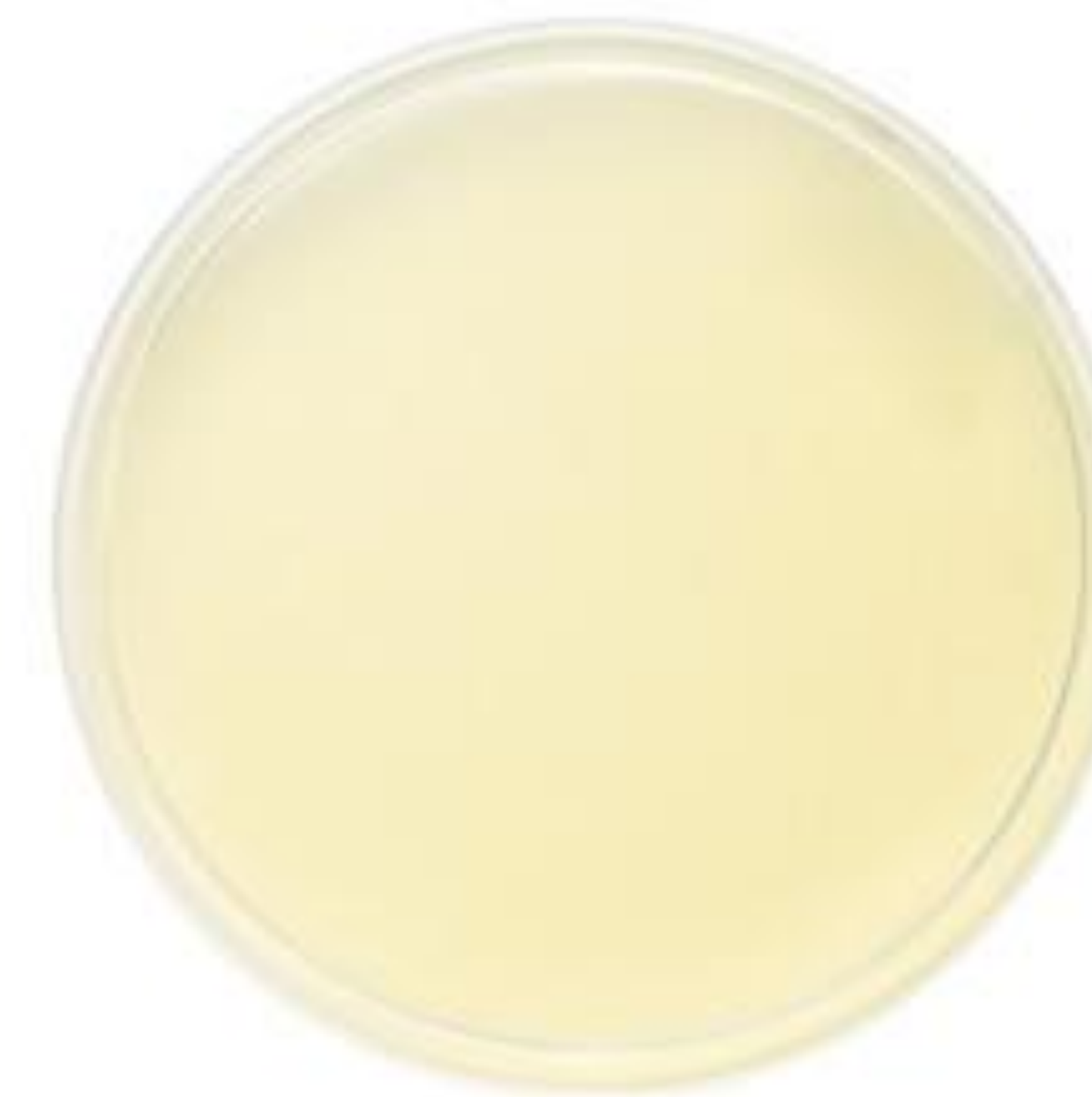
- Steel plate
- Lead plate
- Petri dishes
- Syringes
- Glass dish
- Polystyrene sheet
- Sponge
- Cotton swabs
- 9W UVC Bulb
- E-coli broth (6ml)
- Agar

Procedure

1. Metal plates, sponge, polystyrene, glass and an empty Petri dish were disinfected with the UV light for 60 mins to sterilize them.
2. Surfaces were applied with 1ml of E-coli broth (by syringe).
3. The materials were placed under UV light for intervals of 1 minute ranging from 5 to 10 minutes.
4. For every minute interval, cotton swabs were used to sample the surface.
5. The cotton swabs were wiped onto agar plates.
6. The agar plates were incubated for 2 days.
7. Recorded at what interval each surface experience sterilization, which is reached when no colonies form in the Petri dish.



Left: An example of bacteria colonies in agar (courtesy of Li.M et all, NIH.gov)
Bottom Left: An example of a sterile agar plate (courtesy of adobe stock)
Below: The UV oven used (Modal TK-1-OV)



Results

Lead was sterilized within 7 minutes. Polystyrene, sponge, and acrylic were sterilized within 8 minutes. Glass and steel were sterilized at 9 minutes.

Analysis and Observations

- The colonies that did form were very small, and did not form streaks.
- The colonies were pale, almost white.
- Condensation lined the top of some of the Petri dishes
- All sterilization took place within 5 to 9 minutes, which is within the interval set buy the UV bulb provider (5-10 minutes)

Conclusion

Varying times to sterilization were observed, but no clear relation between sterilization time and surface properties was observed. This test remains inconclusive as to if or how surface properties affect UV disinfection.

Further Studies

- Repeat the experiment with a great precision than 1 minute intervals.
- Repeat the experiment multiple times and average the time taken to disinfect each surface