Characterization of *Staphylococcus aureus* and *Pseudomonas aeruginosa* phages

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ABSTRACT

Widespread usage of antibiotics has created multidrug resistant (MDR) bacterial pathogens. One of the approaches to the antibiotic-resistance is the utilization of phage therapy. Phage targets pathogens and invades the bacterial cells by attaching to the cell surface. They then insert their DNA that then binds to the host bacterial cell's genome. This is the means on how the phages are to be reproduced. After the phages assemble, the bacteria to lyse by disrupting the metabolism. The head of the phage contains a protein coat and also holds the DNA. With the phage structure containing protein, it is expected that the exposure of higher temperatures will denature the phage.
While it is an alternative to antibiotics, there is much still unknown about phages and their characteristics e.g., stability. This is important because phage therapy is a resource that is useful if it can be used as a household treatment or made available for developing countries. In this study, the temperature stability of two phages (i.e., *S. aureus* and *P. aeruginosa* phages) were investigated at four different temperatures. The four temperatures were 55°C, 37°C, 23°C, and 4°C (+/- 3°C). In the end, the two test phages in the experiment had little to no change between 4°C and 55°C at a one-hour period.

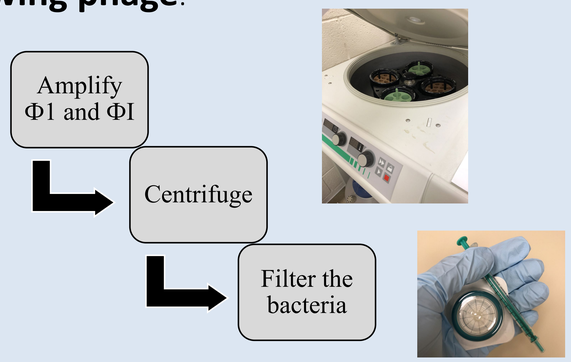
INTRODUCTION

A commonly known antibiotic resistant superbug is the methicillin-resistant *S. aureus* (MRSA). These causes complications of increase infections because the antibiotics will not have an effect on them. Some of the most two most prevalent respiratory bacteria pathogens are the *S. aureus* and *P. aeruginosa.*

- Phages need a host bacterial cell to reproduce by injecting nucleic acid to produce new phage cultures.
- *S. aureus* and *P. aeruginosa* in this case are the host bacteria.
- These experiments are needed to ensure the safety and the impacts of phage therapy in before the potential increase usage of phages as an alternative treatment in the everyday health society of ever-growing antibiotic usage.
- The purpose of phage therapy reintroduction is to allow a wider usage in everyday life in place of antibiotics. To do so, it is important to take in consideration of temperature. If a phage can withstand higher temperature, it can be used in areas of the world near the equator. If phage can be suitable in room temperature, it can be stored in as a household treatment.
- This experiment is to find how temperature can effect phages in hopes to see if phage can be used as therapy in various locations rather than just places that have refrigeration because it can be impactful in many areas of the world.

METHODS

Growing phage:

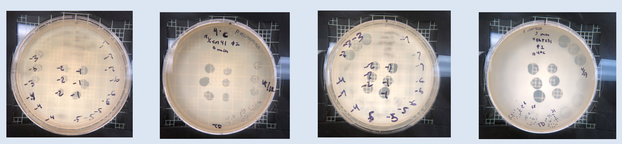


Setting up treatments:

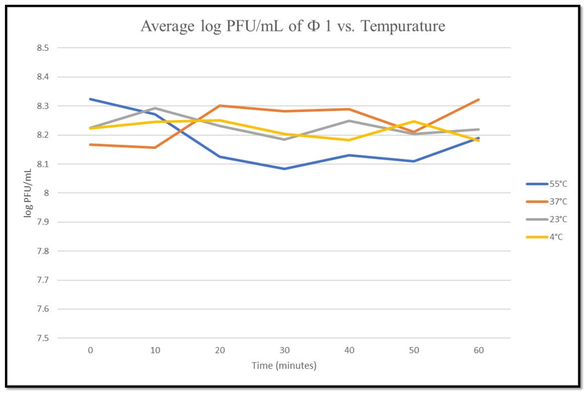
- **1 in 10 phage to SM buffer solution:**
  - **(SM Buffer contains mixtures of NaCl and $MgSO_4$ – Salt Magnesium Buffer)**
  - **2 mL of phage to 18 mL of SM buffer**
- **1 mL of phage stock per time point (x2)**
- **Total time: 60 minutes**
- **Time intervals: Every 10 minutes**

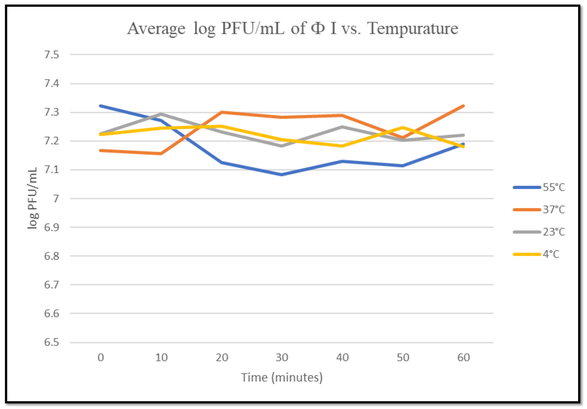
Treatments:

- **Water bath: 55°C**
- **Incubator: 37°C**
- **Room Temperature: 23°C**
- **Refrigerator: 4°C**



RESULTS





CONCLUSIONS

As seen in the results, the difference between the two phages kept at the lower temperature versus the higher temperature had little to no effects. To conclude, the phages have good stability in different temperatures at a one-hour period. This means that the phage can withstand the high temperatures of some of the driest places on Earth that can be around 48°C while also be suitable at room temperature or refrigerated in that time span.

Further studies should be conducted on longer time periods. The one-hour time period was too short to predict the effects of temperature on phages. It is predicted that if phages were in the temperatures for a longer period of time, the effect would be seen more prominent with the highest temperature showing a decrease of phage count while the lowest temperature remaining constant. With the knowledge of the protein heads on phages, higher temperature is expected to denature the phage. This would mean that higher temperature areas would not be able to maintain phage therapy.

ACKNOWLEDGEMENTS

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