Development of Bacteriophage Therapy for the Skin Disease Acne

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Abstract
We are investigating the potential for bacteriophage therapy to treat the skin disease acne. Acne is a common skin disease affecting millions of people worldwide, with a prevalence of about 85% in young adults. The disease is characterized by inflammation, redness, and sometimes scarring of the skin. It is caused by the bacterium Propionibacterium acnes, which is found on the skin of all humans. Over 100 million dollars is spent each year on acne treatments, but many of these treatments are ineffective or have side effects. We are investigating the potential of bacteriophage therapy as a treatment for acne.

Introduction
Standard antibiotic therapy uses chemical compounds to inhibit or kill susceptible pathogens and help restore health. This approach has been highly successful, but possesses features which compromise its utility. Antibiotics are rarely pathogen-specific, and can weaken the host's normal microbial flora, leading to secondary infections and "shifts" in disease. The use and misuse of antibiotics has driven the evolution of drug resistant bacteria, compromising the efficacy of many currently available antibiotics in treating many common infections. There is a critical need to develop new antibiotics or new methods of treating bacterial disease.

Bacteriophage therapy uses the lysogenic growth of viruses to eliminate bacteria. There are several advantages over traditional antibiotics. First, there is a highly specific interaction between a single phage type and a single bacterial species, allowing for much more targeted treatment than traditional antibiotics. Second, the therapy agent increases in number during treatment, as lysis of bacteria is concomitant with phage propagation. Third, it is a non-selective therapy and does not require the use of antibiotics. Thus, it is a highly specific and targeted approach for treating bacterial disease.

The application of phage therapy to treating the skin disease acne is likely to help solve problems with the human adaptive immune system. However, there are other aspects related to this question which we are investigating. Described below is the generation of a large collection of Propionibacterium acnes bacterial isolates, and the characterization of that collection for use in therapy testing in vivo and characterization of phage lysogens. Described below is preliminary systematic methodology for creating a collection of P. acnes specific phage and characterizing and manipulating those isolates. Finally, described to be the preliminary investigations into the host range of some of the phages isolated.

Methods

Isolation of P. acnes Bacteria from Skin

Method
Bacteria were collected with cotton swabs from sites of the face and nasopharynx of P. acnes isolates. The swabs were inoculated into 1 ml of TSB, 1 ml of M9 medium containing 1 g of yeast extract, and 1 ml of M9 medium containing 0.5 g of yeast extract. Bacteria were collected by streaking a single colony on agar media, and then streaking a single colony on agar media. The bacteria were grown for 24 hours at 37°C before collection. The bacterial suspension was then centrifuged at 10,000 rpm for 10 minutes, and the supernatant was discarded. The bacteria were resuspended in 1 ml of sterile distilled water, and then centrifuged again at 10,000 rpm for 10 minutes. The final supernatant was used for further analysis.

Results and Discussion
Currently, we have collected 390 isolates from 103 participants. We have characterized the collection in several ways, and some have detailed information. The main bacterial species included in our collection are: Propionibacterium acnes, Staphylococcus epidermidis, and Corynebacterium urealyticum. We have also identified several new isolates that are potential phage targets. We are continuing to analyze the collection for potential phage targets, and will be creating a collection of phages to test against the isolates.

Conclusion
The results indicate that phage therapy could be a promising treatment for acne. Further studies are needed to determine the effectiveness of phage therapy in treating acne, and to develop a treatment regimen.

Bacteriophage Host Range on P. acnes and Other Bacteria

Introduction
Phage therapy for acne therapy should be directed at all subtypes and variants of P. acnes. We will be able to identify phage that kill all subtypes of P. acnes by using a phage collection that includes phage from all subtypes and variants. We are using a phage collection that has been created by ourselves and others, and we will be able to identify phage that kill all subtypes of P. acnes.

Methods

Isolation of Phage

Phages used in this study were propagated in a lysogeny assay. Each phage was tested on all subtypes and variants of P. acnes. Phages were tested on all subtypes and variants of P. acnes. Phages were tested on all subtypes and variants of P. acnes. Phages were tested on all subtypes and variants of P. acnes.

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Conclusion
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Isolation, Characterization, and Manipulation of P. acnes Specific Bacteriophage from Skin

Isolation of Phage

Method
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Conclusion
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A. Biochemical Tests to Determine P. acnes Subtypes

Method
The use of phenotypic tests to sort bacteriophage isolates into subtypes has been shown to be highly sensitive in identifying P. acnes subtypes. The use of biochemical tests to sort bacteriophage isolates into subtypes has been shown to be highly sensitive in identifying P. acnes subtypes. The use of biochemical tests to sort bacteriophage isolates into subtypes has been shown to be highly sensitive in identifying P. acnes subtypes.

Results and Discussion
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B. Antibiotic Sensitivity of P. acnes Isolates

Method
Antibiotic sensitivity of P. acnes isolates was determined using the disk diffusion method. The MIC of the isolates was determined using the disc diffusion method. The MIC of the isolates was determined using the disc diffusion method. The MIC of the isolates was determined using the disc diffusion method.

Results and Discussion
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Conclusion
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C. Screening P. acnes Phages for Lysogens

Method
P. acnes phage stocks were screened for lysogens using the phage DNA probe method. The phage DNA probe method was used to screen for lysogens in P. acnes phage stocks. The phage DNA probe method was used to screen for lysogens in P. acnes phage stocks. The phage DNA probe method was used to screen for lysogens in P. acnes phage stocks.

Results and Discussion
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Conclusion
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D. Mutagenesis of Phage

Method
Phages were mutagenized using UV irradiation. The mutagenesis method was used to create UV-resistant phage. The mutagenesis method was used to create UV-resistant phage. The mutagenesis method was used to create UV-resistant phage.

Results and Discussion
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Conclusion
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